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FEDERATED MALAY STATES.

ANNUAL REPORT

OF THE

MEDICAL DEPARTMENT

FOR THE YEAR

1931

BY

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KUALA LUMPUR:

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MAP OF FEDERATED MALAY STATES

FEDERATED MALAY STATES.

ANNUAL REPORT OF THE MEDICAL DEPARTMENT FOR 1931.

I.—ADMINISTRATION.

A.—STAFF.

Administration of the Medical Department during the year 1931 was affected by three major factors: the first was the development of the policy of decentralisation of government among the four States; the second was the realisation of the long proposed association of the Medical Departments of the Federated Malay States and the Straits Settlements; the third was the severe financial depression.

At the beginning and during the first half of the year there was still under consideration a scheme for complete administrative amalgamation of medical and health services throughout the Federated Malay States and the Straits Settlements. This step had been recommended on many occasions in the past, as an obvious remedy for the many disadvantages resulting from the division of control between the Principal Medical Officer in Kuala Lumpur and the Principal Civil Medical Officer in Singapore. The retirement of Dr. A. L. Hoops from the post of Principal Civil Medical Officer, Straits Settlements, appeared to offer the opportunity for this amalgamation to be effected, and a detailed scheme was accordingly prepared. The proposals aroused much discussion and considerable criticism; before agreement had been reached, the position was altered by the initiation by Government of a policy of greater decentralisation of administrative authority among the four States of the Federation.

In conformity with this policy it is proposed that medical and health services in each State shall be under the administrative control of a single officer, the State Medical and Health Officer. This will end the dual control exercised under the existing system by the Senior Medical Officer and the Senior Health Officer. Co-ordination between the States will be effected by an advisory officer, and the posts of Principal Medical Officer and Chief Health Officer disappear.

In accordance both with the policy of decentralisation and the need for unification of the Malayan Medical Service, the Principal Medical Officer of the Federated Malay States was appointed to act as Principal Civil Medical Officer of the Straits Settlements, on 9th September; for the remainder of the year administrative control of the Medical Departments of the Colony and the Federation was undivided, and the Malayan Medical Service had one head.

On account of the continuing financial embarrassment, it was found necessary to reconsider the authorized establishment of the department. As the result of discussion between the head of the department and the committee appointed by Government to effect reduction in expenditure, personnel was reduced. Amongst these reductions were the following :

- (1) Senior Surgeon ;
- (2) Ophthalmologist ;
- (3) Second Radiologist ;
- (4) Ten Medical Officers ;
- (5) Eight Health Officers (the actual reduction was only two, since six appointments though appearing in Estimates had never been allowed to be filled) ;
- (6) Two Senior Deputy Medical Officers ;
- (7) Two Deputy Medical Officers ;
- (8) Eight European Nursing Sisters.

The authorized establishment of European officers, on the time scale and above, at the beginning and at the end of the year, with the number of appointments actually filled, is shown hereunder.

	Authorized Establishment.	Appointments filled.	
		1st January.	31st December.
Medical Division	... 68	... 59	... 53
Health Division	... 41	... 30	... 28
Research Division	... 13	... 10	... 10

The principal changes which occurred in the senior appointments during the year were as follows :

Dr. P. S. Selwyn-Clarke left on 19th September, reverting to the West African Medical Service.

Dr. H. G. Holdbrook was transferred to the Straits Settlements as Chief Medical Officer, Penang, on 16th September.

Dr. A. G. H. Smart became Senior Health Officer, Selangor and Pahang, on 27th November.

Dr. E. H. Black, Senior Health Officer, Negri Sembilan, went on leave prior to retirement on 31st December.

Dr. W. F. Samuels, Medical Superintendent of the Central Mental Hospital, went on leave prior to retirement on 20th March.

B.—LEGISLATION.

“The Dentists Registration Enactment, 1931,” was passed at a meeting of the Federal Council on 19th January, and came into force on 24th April. This Enactment makes the practice of dentistry by unregistered persons illegal, and provides for the annual registration of all practising dentists. It follows closely the English law. The need for control of unqualified dentists has long been apparent.

“The Quarantine and Prevention of Disease (Amendment) Enactment, 1931,” was passed at a meeting of the Federal Council on 13th April, and came into force on 19th June. This Enactment prohibits the importation or possession of the virus of yellow-fever.

“The Quarantine Enactment, 1931,” was passed at a meeting of the Federal Council on 13th July, and came into force on the 11th September, 1931. This Enactment supersedes the corresponding part of the previous Quarantine and Prevention of Disease Enactment, 1903, brings local legislation into line with the International Sanitary Convention of 1926.

C.—FINANCE.

The total expenditure on the Medical Department for the year was \$5,834,006 (£645,634). Of this sum, \$3,118,081 (£363,776 2s. 4d.) was incurred under the heading of “Personal Emoluments”; \$2,658,427 (£310,149 16s. 4d.) under “Other Charges”, Annually Recurrent, and \$57,498 (£6,708 2s. 6d.) was Special Expenditure.

In addition to the amount directly expended by the department, the Public Works Department expended \$353,265 (£41,214 5s.) on new buildings for hospitals and other institutions, and \$141,060 (£16,457) on upkeep, repairs, etc.; while a sum of \$548,413 (£63,981 10s. 4d.) was expended on anti-malarial measures from Sanitary Boards and other Government funds.

The revenue of the department was \$406,071 (£47,374 19s.). The total revenue of the Federated Malay States for 1931 was \$52,348,659 (£6,107,343) and the total expenditure was \$62,163,328 (£7,252,388).

II.—PUBLIC HEALTH.

This section, and sections III, IV and V constitute the report of the Chief Health Officer. They have been compiled by Dr. A. G. H. Smart, who was acting as Chief Health Officer, Federated Malay States, at the close of the year.

The year 1931 stands out as a census year, the enumeration of the population taking place at midnight on 1st April. The population as estimated for midyear 1931 on the census return is 1,723,117. This total is practically the same as that estimated for last year by computation from the previous intercensal increase.

The estimated population by race and by State on a geometrical basis for the middle of the year is as follows:

TABLE I.

State.	Malays.	Chinese.	Indians.	Non-Asiatic.	Others.	Total.
Perak	273,230	328,840	161,300	2,377	5,117	770,864
Selangor	123,370	243,360	157,850	2,745	9,431	536,756
Negri Sembilan	86,424	93,784	50,618	876	2,979	234,681
Pahang	110,110	53,750	15,909	394	653	180,816
F.M.S.	593,134	719,734	385,677	6,392	18,180	1,723,117

The increase apportioned to the different States in the recent preliminary census report gives the following figures:

TABLE II.

1931 CENSUS FIGURE PER CENT. INCREASE ON 1921.					
Perak	...	...	...	...	27.87
Selangor	...	...	...	...	32.27
Negri Sembilan	...	...	...	...	30.40
Pahang	...	...	...	...	23.10
Federated Malay States	...	...	...	...	29.20

While immigration to this country from China and India accounted for only about 9,527 persons during the year, the emigration figure amounted to 70,082.

On the other hand there was an actual gain of 24,586 on account of the excess of births over deaths. After balancing the known losses in the shape of repatriations against known gains, there was a net loss to the Federation of 35,969 persons during the year.

The sex ratio as regards individual races is as follows:

TABLE III.

PROPORTION OF MALES TO EVERY 100 FEMALES.

		1911 census.		1921 census.		1931 census.	
Malays	112	...	110	...	106
Chinese	533	...	285	...	203
Indians	325	...	225	...	185

For the whole Federated Malay States the sex ratio is now 157 males to every 100 females as against 181 to 100 in 1921 and 232 to 100 in 1911.

These *known* ratios and rates thus provide a fairly accurate basis on which to estimate the state of the public health and to show the actual progress during the last ten years. Any estimate of the population during intercensal periods in a country, subject to violent periods of alternate commercial prosperity and depression and thus to extremes of immigration and emigration, must be taken with reserve. This is particularly so in large centres, such as Kuala Lumpur, where the census return indicated over a 25 per cent. error in the estimated 1930 population figure.

From the following table it is seen that the proportion of urban population to rural has remained practically the same during the last 20 years. Thus the Federated Malay States may still be classed as a "rural area".

TABLE IV.

Census year.	Urban population.	Per cent. of total population.		Rural population.	Per cent. of total population.	
1911	... 125,107	...	11	...	911,892	... 89
1921	... 201,730	...	15	...	1,123,160	... 85
1931	... 226,631	...	14	...	1,483,162	... 86

TABLE V.

POPULATION, BIRTH AND DEATH-RATES, FEDERATED MALAY STATES, 1931.

Population.	Total births.	Birth-rate.	Total deaths.	Death-rate.
1,723,117 ...	57,457 ...	33.2 ...	32,871 ...	19.1

No method of correction is employed in estimating the birth and death-rates.

TABLE VI.

POPULATION, BIRTH AND DEATH-RATES FOR THE FOUR STATES OF THE FEDERATION 1931.

State.	Population.	Total births.	Birth-rate.	Total deaths.	Death-rate.
Perak	770,864 ...	24,071 ...	31.2 ...	14,641 ...	19.0
Selangor	536,756 ...	19,056 ...	35.5 ...	9,367 ...	17.5
Negri Sembilan	234,681 ...	7,922 ...	33.3 ...	4,802 ...	20.5
Pahang	180,816 ...	6,408 ...	35.4 ...	4,061 ...	22.5

(a) *Birth-rates*.—Births registered during the year numbered 57,457, giving a rate of 33.2, the highest rate on record apart from 1930 with a rate of 36.5.

The natural increase of births over deaths amounted to the satisfactory figure of 24,586.

The birth-rates for England and Wales and London for 1931, respectively, were 15.8 and 15.

The rate for England and Wales was the lowest on record, and is rapidly approaching the death-rate figure.

TABLE VII.

BIRTH-RATE FOR THE PRINCIPAL RACES, 1931.

Malays	37.3
Chinese	31.3
Indians	32.3

The rate for Indians is well above the 1930 rate of 27.9 and constitutes a record, while the rates for the other two races have fallen, particularly the Chinese rate (from 40.9 to 31.3).

Of the total of births registered, 30,028 were males and 27,429 were females, giving a sex ratio of males to females of 109 : 100.

(b) *Death-rates*.—The improvement noted in the death-rate in the Annual Report for 1930 was well maintained during 1931, the rate for the year being 19.1 per mille as compared with 24.1 for 1930, 24.6 for 1929, 28.0 for 1928 and 30.7 for 1927. The 1931 rate is the lowest recorded up to date.

The respective rates for England and Wales and London in 1931 were 12.3 and 12.6.

It will also be seen from the above tables that the death-rates for the various States of the Federation differ only a little, Selangor having the lowest at 17.5 per mille and Pahang the highest at 22.5.

TABLE VIII.

DEATH-RATES FOR VARIOUS RACES, 1931.

Malays	...	...	...	...	...	...	18.8
Chinese	...	...	...	...	...	...	18.9
Indians	...	...	...	...	...	...	20.5

During the previous three yearly periods the death-rate was higher among the Chinese than among any of the other races. This year shows a remarkable reduction however of over eleven per mille in the Chinese rate from 30.4 to 18.9. The death-rate is now highest among the Indian section of the community but even this rate shows a fall of 1.3 per mille over the 1930 figure.

The rate for the estate population (including dependents) showed an even greater fall from 20.6 in 1930 to 15.8 this year.

The rate for Malays shows a fall of 1.6 per mille over the 1930 figure and is still the lowest for the three principal races. The above rates for 1931 may be said to constitute low records for each of the races indicated.

As regards States and races the following table indicates a considerable fall in all cases except for Indians and Malays in Perak. Selangor shows the lowest death-rate of 14.1 for Malays, while Negri Sembilan has the highest for Indians (24.3) :

TABLE IX.

State.	Race.	Death-rate.	
		1930.	1931.
Perak	Malays	18.3	18.5
	Chinese	32.4	19.1
	Indians	19.3	19.7
Selangor	Malays	17.9	14.1
	Chinese	31.5	18.2
	Indians	20.4	19.8
Negri Sembilan	Malays	26.4	20.0
	Chinese	24.7	19.5
	Indians	32.9	24.3
Pahang	Malays	24.0	23.0
	Chinese	27.8	19.8
	Indians	41.8	23.0

A study of the deaths at different age groups for the Federation shows the heavy mortality in the early years of life (38.9 per cent.): another 39.9 per cent. is found during the

working years of life as compared with 12.2 per cent. and 20.3 per cent., respectively, for England and Wales. These latter figures are largely the results of public health control and propaganda over a considerable number of years.

The sex ratio for deaths in 1931 is 100 female to every 148 male deaths or 100 : 92 when correction is made for sex constitution of the population. The latter ratio indicates an alteration from previous experience in that female deaths appear to outnumber male sex for sex.

The following table shows the ratio of male deaths to every female death by races (uncorrected).

TABLE X.

Malays	...	...	...	...	...	...	107
Chinese	...	...	...	...	...	...	222
Indians	...	...	...	...	...	...	121

(c) *Infant Mortality Rates*.—As noted in last year's report in a country like this where birth registration is more or less complete and when death registration of infants under one year of age can be fairly well relied upon the infant mortality rate serves as an important index of health conditions.

In the Federated Malay States the loss of infant life is still very high as compared with European standards (England and Wales 66 and London 67 in 1931). The recorded rate for 1931 of 139 deaths per 1,000 living births is the lowest on record so far, however. The infant mortality rate shows a gradual but more or less progressive fall during the last decennium, but about one quarter of the total deaths are still infant deaths in the Federated Malay States.

The rate among Malays was again the lowest among the principal races as the following table shows:

TABLE XI.

Race.	Infant mortality rate.		
	1930.	1931.	
Malays	160 ... 135
Chinese	173 ... 148
Indians	199 ... 154

A satisfactory fall was recorded for each race, however.

As in previous years malaria and the group of "fevers of undefined origin" were responsible for the greater proportion of deaths (40.1 per cent.).

The rate of 7.6 for 1931 showed a decrease over the 1930 figures of 9.7.

Next in order of precedence came “convulsions”, a term indicating in most cases an end symptom merely. It was attributed as causing nearly 4,000 deaths.

Non-tuberculous diseases of the respiratory system, chiefly pneumonia, took third place in order of importance followed by pulmonary tuberculosis and a group of diseases of the alimentary tracts confined to dysentery and diarrhœa.

III.—HYGIENE AND SANITATION.

GENERAL REVIEW OF WORK DONE AND PROGRESS MADE.

1.—MOSQUITO AND INSECT-BORNE DISEASE.

(i)—Malaria.

The group of diseases which includes malaria and fevers of undefined origin was responsible for over 40 per cent. of the total deaths recorded in 1931, but the actual figures for deaths from diagnosed malaria in the Federation as compared with that from fevers of undefined origin for 1931, are of some interest.

TABLE I.

Disease.	Perak.	Selangor.	Negri Sembilan.	Pahang.	Total.
Malaria... ..	687	411	261	157	1,516
Fevers of undefined origin ...	5,700	2,646	1,387	1,931	11,664
All causes	14,641	9,367	4,802	4,061	32,871
Percentage ratio of deaths from malaria to deaths from all causes	4.7	4.4	5.4	3.9	4.6
Percentage ratio of deaths from malaria and deaths from fevers of undefined origin to all causes	43.6	32.6	34.3	51.4	40.1

It will be noted that the percentage ratio of deaths from malaria to deaths from all causes is still the highest in Negri Sembilan as noted last year. This is a State in which hilly country predominates.

Preventive measures against malaria include the following:

(a) *Notification of Cases.*—Is confined to those areas which come under the control of Mosquito Destruction Committees of Sanitary Boards, which replaced the Mosquito Destruction Boards of all States in February, 1930.

Such notifications represent only a small proportion of the total cases treated, as apart from estates of 25 acres or over which submit monthly returns to the Health Branch, no notifications of malaria are recorded from rural areas.

In Mosquito Destruction Committee areas all notifications of fresh infections are followed up by the Health Staff and action taken where necessary.

Three thousand four hundred and forty notifications were made during the year from Mosquito Destruction Committee areas in the four States. Of these, 808 were diagnosed as fresh infections.

(b) *Routine and Special Surveys.*—Routine and special surveys still continued to form a very important section in anti-malarial control work throughout this country.

In urban areas each fresh case of malaria discovered was followed by a check survey. This routine led in Kuala Lumpur to the discovery of a hitherto undiscovered vector of malaria—*A. hyrcanus nigerrimus* and to the finding of *A. ludlowi* as the carrier in the case of a small outbreak among the staff of the Quarantine Camp, Port Swettenham.

In rural areas such surveys are carried out under the supervision of officers of the Health Branch or by the Visiting Medical Practitioner of the estate concerned.

Endeavours are made in urban areas to control the breeding of all species of anophelines and, even where possible, of culicines within a $\frac{1}{2}$ mile radius outside the boundaries of towns. The principle adopted in connexion with towns is to sub-divide such areas as are under anti-malarial control in such a way as to ensure the full examination of each area at least once a week.

(c) *Temporary and Permanent Anti-malarial Work.*—Anti-malarial measures in the Federated Malay States in the form of anti-larval action may be classed as temporary and permanent measures.

Additions to permanent anti-malarial drainage were carried out in the larger centres of population particularly in Kuala Lumpur, Kuala Kubu Bahru, Sungei Buloh Leprosorium, Tampin, Kuala Lipis and Raub. The general and widespread depressed economic position prevailing considerably limited the scope of this work during the year particularly in such large centres as Kuala Lumpur.

Temporary anti-malarial work also had to be considerably curtailed, new work or extensions being reduced to the minimum. In certain of the larger Sanitary Board areas, notably Kuala Lumpur, the principle of requiring owners of land in need of anti-malarial filling or drainage to pay the costs of such measures was further extended, a considerable saving to Government being the result.

The expenditure on temporary and permanent anti-malarial work from funds controlled by the Anti-Malarial Committees of the various Sanitary Boards is indicated in the following table :

TABLE II.
ANTI-MOSQUITO WORK, FEDERATED MALAY STATES, 1931.

—	EXPENDITURE FROM M.D.C. FUNDS.								
	Temporary work.					Permanent work.			
	Oiling.			Ditching or other temporary work.		Buried drains.		Open drains.	
	Amount of oil in gallons.	Total cost of oil.	Cost of necessary labour.	Chainage.	Total cost of work including labour.	Chainage.	Total cost of work including labour.	Chainage.	Total cost of work including labour.
	2	3	4	5	6	7	8	9	10
1		\$	\$		\$		\$		\$
Perak ...	167,011	34,072.93	10,061.39	45,960.0	40,657.56	28.45	387.41	10.0	575.65
Selangor ...	222,395	43,194.33	21,736.03	24,670.7	36,399.05	...	1,192.59	59.5	2,177.00
N. Sembilan ...	51,349	9,388.23	5,692.82	14,205.5	4,420.05	33.0	135.00	7.0	271.00
Pahang ...	103,568	23,538.76	5,121.70	31,736.0	24,445.54	3.0	4,832.71	...	...
Total ...	544,323	110,194.25	42,611.94	116,572.2	105,922.20	64.45	6,547.71	76.5	3,023.65

—	Minor works and maintenance.	Miscellaneous expenditure.	Total M.D.C. ex- penditure of temporary and permanent work.	Cost per head of population.	Expenditure from funds other than M.D.C. Funds.			Grand total expendi- ture on Anti- malarial work.
	11	12	13	14	Work carried out from special votes.	Miscellaneous expenditure.	Maintenance of existing work.	
	\$	\$	\$	\$	\$	\$	\$	\$
Perak	36,403.07	36,626.23	159,583.73	1.08*	10,615.77	374.92	9,332.22	179,906.64
Selangor	21,422.88	19,064.45	160,202.18	0.71*	20,384.57	...	1,125.59	189,712.34
N. Sembilan ... ..	...	...	37,228.62	1.00*	992.65	2,124.51	24,149.25	64,495.03
Pahang	40,382.98	18,549.23	85,687.00	1.66†	15,245.55	4,090.56	9,276.75	114,299.86
Total	98,208.93	74,239.91	450,701.53	1.11	47,238.54	6,589.99	43,883.81	548,413.87

(d) *Distribution of Quinine.*—Quinine was distributed as formerly free to various Government institutions and persons during the year.

(e) *Periodical Inspections of Government and Estate Labour, School Children, etc.*—Some 7,500 visits were paid during the year to estates over 25 acres in size, Government cooly lines, schools, etc., by the various members of the Health Branch and inspection carried out which included investigation into the incidence of malaria.

In spite of the fact that there was some slackening off in anti-malarial measures and medical supervision on estates as a result of the depressed economic state of the country the malaria figures, on the whole, showed an improvement on those of previous years.

* Cost per head of population in controlled areas only.

† Figures not available for Pahang East.

It must be remembered and emphasized however that undoubtedly many malaria "carriers" among the Indian population, which forms the bulk of the total estate population in this country, were repatriated during the year.

There was no outstanding epidemic of malaria during the year but minor outbreaks were reported from the Brickfields Road area, Kuala Lumpur, the Quarantine Camp, Port Swettenham, and on several mines and estates.

(f) *Anti-malarial Measures affecting Estate Land and State Land in Rural Areas.*—Six schemes were commenced and one, previously started, continued during the year in Selangor and Negri Sembilan to improve the general health condition in the vicinity of estates. These schemes were framed under the Health Boards Enactment.

It is too early to give an opinion as to general results following the work undertaken but in three cases outbreaks of malaria were no doubt prevented by the issue of certificates of urgency under the Enactment.

(g) *Propaganda.*—As in previous years, propaganda again mostly took the form of notices in the public press and the issue of posters and pamphlets to teaching institutions in the towns and districts.

A concentrated effort in public education was again undertaken at the Malayan Agri-Horticultural Exhibition held in Kuala Lumpur during the August Bank Holiday. The majority of the 24,000 people who visited this Exhibition received lecture-demonstrations in infant and child welfare and on malaria and general hygiene.

A Health Week was held in Taiping during the year, and has been the subject of a special report. It caused considerable interest amongst the visitors.

There is now a section on Public Health in the Damansara Road Museum, Kuala Lumpur, and several smaller museums are in existence in various Health Offices throughout the country.

During the year, Malay Inspectors toured the districts of Selangor and Perak giving propaganda lectures in schools, villages and kampongs.

Personal propaganda was also carried out by Health Officers on estates and in towns and included lectures to such groups as the Malay students in the Co-operative Department.

Twenty-one estate dressers and 15 anti-malarial workers received instruction at Health Offices.

Cinematograph films were exhibited illustrating anti-malarial and public health measures in various towns and rural areas throughout the year and attracted large audiences.

(h) *Special Investigations*.—Among the special investigations carried out during the year the following are worthy of particular note :

- (1) A minor outbreak of malaria occurred in the Brickfields Road area of Kuala Lumpur and an investigation was undertaken by the Institute for Medical Research at the request of the Health Branch. Mosquitoes were trapped at night and later on dissected.

Larval surveys indicated that *A. hyrcanus* was the predominant breeder in the area.

Although the Director of the Institute reports that there is little doubt that this species of anopheline was functioning as a carrier in the Brickfields Road area of Kuala Lumpur it has not apparently carried in other parts of the town or in other towns and cannot, in consequence, be looked upon as a certain carrier. This is fortunate as *A. hyrcanus* is to be found in a wide range of natural waters and its eradication would be very difficult. A detailed report on this work will no doubt be published by the Institute for Medical Research in due course.

- (2) Experimentation was also started in Kuala Lumpur by the Entomologist, Institute for Medical Research, and the Health Officer with three different oiling mixtures in the field in the hope of devising an all-round satisfactory oil for general anti-malarial purposes, and definite results were attained which will doubtless be published later on.
- (3) Laboratory experiments on the larvicidal properties of mineral oils carried out at the Institute for Medical Research, Kuala Lumpur (Bulletin No. 5 of 1931), during the year showed that the larvicidal properties of oils have little relation to their commercial specification and that oils bearing the same name give widely divergent results.

The oil in use at the moment is the so-called Mosquito Destruction Board mixture consisting of 45 parts Solar, 15 parts Diesel (heavy) and 4 parts of light (Kerosene) oil.

- (4) An outbreak of malaria among the police force stationed at Sungei Besi—a small Sanitary Board area where it is impossible to undertake any effective anti-larval measures—offered an opportunity to try out the effects of drug prophylaxis and the Institute for Medical Research started an experiment on these lines using quino-plasmoquine.

A controlled experiment on the effect of plasmoquine on the gametocyte rate in labourers on a rubber plantation undertaken some time ago by the Institute for Medical Research indicated a marked reduction on the incidence of clinical malaria, a slight

improvement on the splenic index and average hæmoglobin percentage and consequently a great improvement in the general physical condition of the labourers. (Bulletin No. 3 of 1931, I.M.R.).

- (5) An experiment was also commenced in the Coast district of Selangor with *Duranta* and *Mikania Scandens*—two plants said to inhibit *A. maculatus* breeding by providing early shade.
- (6) An investigation of malaria in Malay kampongs in the Ulu Langat district of Selangor showed that infection was mostly due to *A. umbrosus*.
- (7) An outbreak of malaria at Port Swettenham followed by adult trapping revealed the fact that *A. ludlowi* was the carrier concerned and that breeding was taking place outside the controlled area.
- (8) The report on a special investigation carried out by Professor K. B. Williamson at Cameron Highlands during the year is not yet available but will no doubt be forwarded later.
- (9) Nearly 25,000 examinations with identifications of larvæ were made in Selangor during the year.

Of 7,802 imagines captured in cattle-sheds, abattoirs, private houses and in box and human traps in Kuala Lumpur, none were found to be *A. maculatus*, *A. umbrosus*, or *A. ludlowi*.

(ii)—Dengue.

Dengue or dengue-like fevers are met with frequently but not commonly recorded in spite of the fact that the larval index of *A. albopictus* and *A. argenteus* is high.

2.—EPIDEMIC DISEASES.

(i)—Plague.

No cases of plague were reported during the year and as noted in last year's report the Federation has now been clear of this disease since 1927.

Anti-plague measures include attention to housing, the provision of rat-proof godowns at the main ports of entry, and improvements in refuse disposal in Sanitary Board areas.

Trapping and poisoning of rats was carried out in a limited way.

In Kuala Lumpur 2,704 rats were caught in traps, and 639 at Port Swettenham were inspected and the flea index ascertained. Some 503 fleas were recorded giving an index of .78.

With few exceptions the fleas belonged to the species *Xenopsylla cheopis*.

Apart from trapping attacks with barium carbonate were also carried out, this being one of the cheapest, most effective and safest of the poisons recommended.

All the rats caught were of the same variety as formerly—*Rattus rattus diardi*.

A supply of plague vaccine was prepared and kept at the Institute for Medical Research as in former years.

(ii)—Cholera.

No cases of cholera were reported during the year and this disease has been absent from the country since 1927, when a small outbreak occurred.

Supplies of cholera vaccine were prepared and kept in readiness at the Institute for Medical Research for use in case of any emergency.

(iii)—Smallpox.

An outbreak limited to 19 cases occurred in Perak in 1931 probably a carry on of the cases which occurred in mild form in the latter half of 1930, and one case was reported from Selangor. Three deaths were recorded for the Federation giving a case mortality rate of 15 per cent.

As noted in previous years the majority of the cases were among Malays twelve, seven being Indians, and one Chinese (Selangor).

Cases continued to occur in Province Wellesley throughout the year and it is probable that this area served as the focus of infection.

The new Vaccination Enactment came into force during the year making vaccination compulsory and giving provision for the promulgation of orders for general vaccination within particular areas (sec. 15).

Four orders were made under this section during the year.

Care was taken to see that all immigrants were vaccinated at Port Swettenham if not already so treated at the port of embarkation. One thousand six hundred and seventy Indians were so vaccinated.

The following is a summary of vaccinations performed during the year :

TABLE III.

State.	Total vaccinations, Medical and Health Branches.		Vaccination by Health Branch.		No. in which result is known.		Percentage successful.*	
Perak	67,773	...	56,929	...	14,926	...	24.4
Selangor	35,055	...	28,105	...	17,626	...	57.3
Negri Sembilan	...	8,195	...	8,195	...	5,377	...	65.6
Pahang	4,908	...	4,205	...	3,944	...	93.0
Total	115,931	...	97,434	...	41,873	...	60.1

The lymph used was again prepared and issued by the Institute for Medical Research, Kuala Lumpur.

* Based on vaccinations carried out by Health Branch.

(iv)—Japanese River Fever.

Three cases of Japanese river fever with one death were reported during the year (from the State of Pahang) as against six cases with one death in 1930.

With its present incidence this disease cannot be considered of much practical importance from the public health standpoint in this country.

Further information should be sought in the records of the Institute for Medical Research, where a considerable amount of work has taken place in the last few years on the local vector and other factors concerning this disease.

(v)—Typhus.

The only typhus reported is of the tropical variety, first described in Malaya by Fletcher in 1924.

The frequency of this disease and the increasing mortality during the past four years is shown in the sub-joined table.

TABLE IV.

Year.	No. of cases.		No. of deaths.		Case mortality rate.	
1928	...	57	...	4	...	7.0
1929	...	166	...	11	...	7.2
1930	...	176	...	22	...	12.5
1931	...	204	...	32	...	15.7

Table V indicates the position by States for the year.

TABLE V.

State.				Cases.		Deaths.	
Perak	...	...	...	37	...	1	...
Selangor	...	...	...	122	...	27	...
Negri Sembilan	...	...	...	20	...	2	...
Pahang	...	...	...	25	...	2	...
				204	...	32	...

A study of 119 cases reported to the Health Officers, Kuala Lumpur town and Selangor East district, shows that all these were confined to the working age groups.

Of the 122 Selangor cases, 105 were apparently infected on rubber and oil palm estates, thirteen in towns and villages and four in rural areas apart from estates. Thus the majority of the patients were Indians of the cooly class.

Information on this disease is contained in the Annual Reports of the Institute for Medical Research where further investigation was carried out during the year.

(vi)—Enteric Fever.

Two hundred and eighty-eight cases and 87 deaths were recorded from fevers of the enteric group, giving a case mortality of 30.2 per cent. This is high and indicates that a large number of cases are not reported.

The death-rates from this disease by States are as follows :

TABLE VI.

State.	No. of deaths.	Death-rate per 100,000.
Perak	47	6
Selangor	16	3
Negri Sembilan	12	5
Pahang	12	7
Total	87	5

This shows a decrease over the 1930 rate of 7.3 per 100,000.

The incidence of enteric fever based upon cases admitted to all Government hospitals showed a decrease over the 1930 figure of 22 to 17 per 100,000.

A small outbreak occurring in Kuala Lumpur appeared to point more or less definitely to a source among food hawkers and it is likely that this may be one of the chief sources of the disease in this country.

No "eruptive" tendency was exhibited during the year, a fact indicating that cases did not arise from a common or "public" source, such as a water or milk supply.

Anti-typhoid inoculation was carried out and was available to all persons desiring such protection.

(vii)—Dysentery, Diarrhoea and Enteritis.

This group of diseases was responsible for 1,606 deaths during the year, approximately 5 per cent. of the total deaths. This compared with 2,440 deaths in 1930 or 5.9 per cent. of the total.

A death-rate of 141.6 per 100,000 was recorded from these causes.

The distribution by States was as follows :

TABLE VII.

State.	No. of deaths.	Death-rate per 100,000.
Perak	446	58
Selangor	713	133
Negri Sembilan	257	109
Pahang	190	105

Selangor with a rate of 133 is thus seen to have replaced Negri Sembilan which had the worst record in 1930 (80 per 100,000).

(viii)—Cerebro-spinal Meningitis.

A total of seven cases was reported including three in Perak and four in Selangor.

Six deaths were reported giving a case mortality of 85.7 per cent. and a death-rate of 0.34 per 100,000 as compared with a rate of about 1 per 100,000 in 1930 (eighteen deaths).

(ix)—Diphtheria.

The number of cases reported again showed an increase over previous figures. In 1931 there were 143 cases reported with 29 deaths as compared with 112 cases in 1930 with 31 deaths and 88 cases in 1929 with 27 deaths.

The position by States was as follows :

TABLE VIII.

State.	Cases.	Deaths.
Perak	59	16
Selangor	57	11
Negri Sembilan	9	1
Pahang	9	1
Total ...	134	29

The death-rate is thus seen to be 1.7 per 100,000.

The case mortality rate of 21.6 per centum (compared with 27.7 in 1930) is high as compared with such countries as England and Wales, Germany and Denmark, but the deaths recorded should no doubt be spread over a greater number of cases.

The fatality rate per centum was only 5.5, 6.3 and 2.5 respectively in these countries in 1929.

In the Federated Malay States the disease would appear to be more an urban than a rural one in character. For instance, in Kuala Lumpur 39 cases were notified with four deaths.

Taking the disease in Kuala Lumpur town and comparing the figures with those of Perak it is found :

(a) the case distribution as follows :

	Chinese.	Indians.	Malays.	Others.
Perak	43	5	4	7
Kuala Lumpur ...	23	10	1	5

(b) the age incidence worked out as follows :

TABLE IX.

Age.	Perak.	Kuala Lumpur.
Under 5	38	25
5-10	13	9
15-20	5	3
Over 20	3	2

Pasteurisation of milk supplies in the larger areas of population is not yet employed and under existing conditions it is impossible to exercise adequate supervision over dairymen and milk vendors.

Nasal swabbing combined with throat swabbing was commenced in Kuala Lumpur among diphtheria contacts it being recognized that by the throat swab alone a reliable carrier rate is not possible.

Little was done in the way of immunization during the year apart from some research work carried out at the Institute for Medical Research.

(x)—Yaws.

Out of 404 cases treated in Perak during the year, all were Malays except five Indian girls discovered. This was the result of tour campaigns carried out in the Taiping district.

One hundred and six cases, the majority from the Temerloh and Kuala Lipis districts, were all Malay boys.

Treatment for this disease is available at all District Hospitals and propaganda is carried out in kampong areas.

3.—OTHER DISEASES.

(i)—Leprosy.

The Leprosy Enactment No. 23 of 1926 provides for compulsory segregation of lepers except in certain special cases where the Health Authorities may permit home segregation. The majority of the cases notified are now segregated at the new Leprosorium, Sungei Buloh, near Kuala Lumpur, but several hundred are still isolated in the old Leper Asylum situated within the limits of that town.

Thirty-six cases were notified to the Health Department all being from among the Chinese section of the community during the year and the usual action taken.

(ii)—Pneumonia.

This disease was again responsible for a very heavy toll of life accounting for about eight per cent. of the total deaths.

Deaths numbered 2,786 giving a death-rate per mille of 1.6 as compared with 1.8 in 1930.

The distribution by States was as follows :

TABLE X.

State.	No. of deaths.	Death-rate.
Perak	745	96.6
Selangor	1,061	197.7
Negri Sembilan	633	269.7
Pahang	347	192.6
Total	2,786	161.7

The following table gives a comparison of deaths from pneumonia among the estate population and the principal towns during the year:

TABLE XI.

State.	Estate population.	Deaths.	Death-rate per mille.	Town population.	Deaths.	Death-rate per mille.
Perak	45,965	85	1.9	143,068	136	1.0
Selangor	85,617	197	2.3	148,856	108	.99
Negri Sembilan	52,577	159	3.0	21,770	55	2.5
Pahang	13,120	57	4.3	18,760	34	1.8

This indicates the higher death-rates on the estate areas. Pahang is seen to give rates in both cases about double those for each Perak and Selangor.

(iii)—Tuberculosis.

Tuberculosis again accounted for a large number of deaths and can still be classed as one of the major fatal diseases of the Federation although the death-rate per mille fell from 1.3 in 1930 to .9 in 1931.

The majority of deaths were from phthisis (pulmonary tuberculosis) being 90 per cent. of total deaths from tuberculosis.

The distribution by States for 1931 was as follows:

TABLE XII.

State.	Deaths from pulmonary type.	Death-rate per 100,000.	Deaths from all forms.	Death-rate per 100,000 from all forms.
Perak	586	76.0	661	85.7
Selangor	500	93.1	521	97.1
Negri Sembilan	265	112.9	269	114.6
Pahang	173	95.7	173	95.7
Total	1,524	88.4	1,624	94.2

Pulmonary tuberculosis is compulsorily notifiable in certain of the larger Sanitary Board areas of the Federation only. Even in them a comparison of notifications and deaths makes it clear that a large proportion of cases are not notified until they are found at death. A study of 124 deaths recorded in the report of the Health Officer, Kuala Lumpur, shows that the bulk of this disease is to be found among the Chinese (76 deaths).

Records taken from the town of Kuala Lumpur give the following non-pulmonary forms of tuberculosis as recorded from within the Sanitary Board area during the year:

Tubercle of the spine	17 cases
„ „ abdomen	7 „
„ „ joints	1 case

Most of the cases reported are of the advanced type—the type which is the principal source of infection.

Tuberculosis among animals is rarely recorded and no records of any tuberculous milk having been discovered are available.

A propaganda film called the "Rescue of Swee Kim" was shown in various kampongs and towns throughout the country.

Spitting is now an offence under the Minor Offences Enactment.

(iv)—**Convulsions.**

This term is still used as a common cause of death. It may be said to be merely a general term indicating an end symptom used by the untrained observer.

It was attributed as the cause of death in about 4,000 cases in 1931.

(v)—**Tetanus.**

Ninety-five deaths were recorded from tetanus during the year; about 65 per cent. occurred during the first year of life.

The following table gives the deaths by States:

TABLE XIII.							Deaths.
State.							
Perak	...	...	...	...	...	...	46
Selangor	...	...	...	...	...	...	27
Negri Sembilan	...	...	...	...	...	...	17
Pahang	...	...	...	...	...	...	5

4.—**HELMINTHIC DISEASES.**

(i)—**Ankylostomiasis.**

This disease is not a common cause of death although a high percentage of certain classes of the population is infected and it produces a lowered resistance to disease.

(ii)—**Ascariasis.**

Infection with *A. lumbricoides* is very common.

(iii)—**Other Helminthic Disease.**

Cestodes are rarely reported as a cause of illness and no case of trichinosis was reported in man or pig.

5.—**GENERAL MEASURES OF SANITATION.**

(i)—**Sewage Disposal.**

The larger centres of population in the Federation employ the "pail" method of night-soil disposal. In the principal towns the "town bucket system" is in vogue.

No town yet possesses a water-borne sewerage system. This question again received attention in the Federal Capital during the year and a site for sewage works was chosen.

Where the pail system is employed, night-soil is conveyed either by lorry, bullock-cart or hand-cart to entrenching grounds.

Four towns in Kinta dispose of bucket washings at the entrenching grounds by means of septic tanks.

It is proposed to instal a similar system in Kuala Lumpur in the near future. Towns like Kuala Lumpur and Ipoh also make considerable use of the small septic tank. Water-carriage public latrines have also been installed in these centres during the last year or two and are much used.

Of the septic tank installations, Selangor possesses some 240 and Perak 60, serving clubs, hospitals, schools, private houses, etc. The question of standardizing these was taken up during the year.

A sum of \$37,650 is estimated to be spent on septic tank installations, public latrines and bucket-washing stations in the Federation in 1932.

The question of improving the existing pattern of Sanitary Board type latrine received attention during the year and various improvements on fly proofing and general design were tried out with varying success.

In the smaller centres pit latrines are still very common. Very often these are found in close proximity to the household water supply. Steps were taken to extend local piped supplies where these existed, to close dangerous earth-wells, and to insist on a better type of pit latrine.

(ii)—Refuse Disposal.

Refuse disposal in the larger townships consists in the removal of all rubbish from house and street bins to covered motor lorries which convey it to an incineration area.

Incinerators vary from the most modern type of destructor—as seen in Kuala Lumpur to the “Beehive” and “Drum” type employed in the smaller towns and villages.

In the larger centres of population a daily system of refuse collection is carried out.

Two new type house bins were tried out during the year: an automatic self-closing bin and a concrete bin built into the rear wall of the premises. The latter type was given an extensive trial in the shop-housing areas of Kuala Lumpur and proved very useful.

(iii)—Drainage.

Anti-malarial drainage has been dealt with in the section dealing with “malaria”.

Concrete drainage schemes were further extended to town areas as far as funds permitted.

It is expected that the river deviation schemes now in hand particularly in Kuala Lumpur will do much to materially improve existing drainage conditions and go far to minimise the possibility of flooding.

(iv)—Street Stalls and Hawkers.

The street stall and the hawker each present a difficult public health problem. There is no doubt that these in most cases are a potential source of danger to the public.

(v)—Kongsi-houses.

Kongsi-houses are temporary buildings constructed for the use of labourers employed on work and built on the site of operations.

Criticism of these structures was raised during the year in Sanitary Board areas and much was done to improve them from the sanitary standpoint.

The average kongsi consists of a bamboo and attap structure with an earth floor and drains. Contractors are now encouraged to house their workmen in available empty permanent dwellings wherever possible and where this is not possible these kongsis are supervised and controlled.

(vi)—Water Supplies.**A.—TOWNS.**

Considerable attention was devoted to water supplies throughout the country during the year under review.

The supplies for the towns of the Federated Malay States are derived from three main sources:

- (a) Upland jungle streams with small impounding basins or dams;
- (b) Heavily polluted rivers or canals containing much silt;
- (c) Wells.

Examples of (a) are to be seen at Kuala Lumpur, Ipoh and Seremban, three of the chief towns, while Gemas and Teluk Anson may be classed under (b) and most of the smaller towns and villages under (c).

The general policy adopted by the Health Branch during the year was to recommend chlorination of all public supplies in addition to filtration and storage wherever practicable, including the use of lime and alum according to local conditions, and the employment of mechanical rapid rather than slow sand filters.

The advantages gained by covering all service reservoirs was also stressed.

Improvements in town supplies during the year included:

(a) PERAK.

New Kinta Water Supply.—An extension of this supply was made in Ipoh Old Town, Batu Gajah, Pusing, Tronoh, Menglembu, Lahat and Papan.

The water was chlorinated towards the end of the year but the results are not yet entirely satisfactory.

The service reservoir at Chemor in Perak was covered and new reservoirs were opened at Lahat and Batu Gajah. These measures resulted in their being no serious shortage of water in this area of the country as in previous years.

Lower Perak.—Chlorinating plants were added to the Teluk Anson and Bagan Datoh and Tanjong Malim supplies during the year.

An artesian well is being constructed at Pulau Tiga on the river Perak in an attempt to find a satisfactory water supply for the surrounding riverine population.

(b) SELANGOR.

Kuala Lumpur Supply.—Owing to the unsatisfactory standard of this supply chlorination experiments were carried out, during the year, using (a) caporite; (b) gaseous chlorine.

It was finally decided to use the latter method, and further apparatus for this purpose is now on order.

The water supply goes through various small sedimentation tanks, then passes through slow sand filters and is stored.

During the year the supply was extended to the outlying Setepak and Segambut areas of the town and the small areas within the town itself by the erection of standpipes.

Selangor Inland Districts.—The water supply to the Serdang Government Plantation was completed during the year and included mechanical filtration and chlorination and a covered reservoir. Extensions were also made to the new Kuala Kubu Bahru water supply.

The new supply for the towns of Kepong and Sungei Besi Bahru was made available early in the year.

Various improvements to other supplies, notably in Klang and Ulu Langat districts in Selangor, were postponed owing to lack of the necessary funds.

Negri Sembilan and Pahang.—Provision was made during the year for the chlorination of the water supplies at Kuala Pilah and Tampin in Negri Sembilan, and a sum of \$4,000 is estimated to be spent on this work in 1932.

There is a piped and treated supply in the towns of Bahau, Gemas and Kuala Lipis in Pahang. Supplies to Mentakab and Temerloh were installed during the year.

Fraser's Hill.—Improvements to the Fraser's Hill supply were completed and the water is now treated with alum, passes through a mechanical filter and is finally chlorinated.

B.—VILLAGES, ESTATES AND MINES.

Although a number of the larger villages situated near the main centre of population are supplied by the public water supplies of these places, the usual drinking water in the average village comes from unprotected and shallow wells.

A sum of \$3,500 is estimated to be spent in 1932 on protected well supplies to a number of the villages in Perak and provision for this was asked for in the case of others in the Federated Malay States.

Most estates and mines also obtain their water supply from shallow wells. These are for the most part now protected. A few make use of water from hill streams, using mechanical filters and sometimes chlorination.

(vii)—Offensive Trades.

By-laws exist in all Sanitary Board areas regulating and licensing offensive and dangerous trades and in most of the larger towns efforts are made apparently with varying success to confine such trades to definite districts.

In Kuala Lumpur and Kinta 648 such premises were licensed and prosecutions for a breach of the law were instituted in 111 cases, convictions being obtained in 92 of these.

(viii)—House Inspection.

House to house inspections are carried out in all Sanitary Board areas.

The chief sanitary defects were as usual overcrowding, unauthorised cubicles and partitions, dirty premises and latrines, insufficient lighting and ventilation, inadequate open areas, and the occurrence of nuisances.

In Kuala Lumpur 14,313 notices were served for the abatement of various nuisances and 2,223 prosecutions were instituted leading to 1,866 convictions, and the Senior Health Officer, Perak, reports the demolition of many insanitary houses in Taiping during the year.

6.—ESTATE VISITING.

The number of visits to estates carried out during the year by officers of all ranks of the Health Branch was 4,038.

This number does not include special advisory visits made at the request of estate managements, or in connection with anti-malarial schemes under the Health Boards Enactment.

The duties of the Health Branch on estates are advisory only, and the executive work is carried out by visiting medical practitioners where these are employed.

Many check mosquito surveys were however made at the request of managers in connection with Health Branch schemes and routine anti-malarial work and visits were made on account of reports of infectious diseases.

Table XIV shows the amount of work involved :

TABLE XIV.

State.	*No. of large estates.	†No. of small estates.	Total.	Acreage of large estates.	Acreage of small estates.	Total acreage.	‡Estate labourers.	§Total population.
Perak .	463	459	922	396,654	22,451	417,105	52,721	79,681
Selangor ...	413	257	670	399,272	14,145	413,417	57,476	88,025
N. Sembilan	417	475	892	310,089	23,910	333,999	43,727	52,577
Pahang ...	197	424	621	198,567	21,343	219,910	10,773	13,120
Total ...	1,490	1,615	3,105	1,304,582	81,849	1,386,431	164,697	233,403

* Large estate is one of 100 acres and over.

† Small estate is one over 25 and under 100 acres.

‡ This number relates to the average monthly total of labourers employed on all estates whether included in Health Board Schemes or otherwise.

§ Including dependants.

The following points receive particular attention at visits :

- (1) Health condition of the labourers and dependants, including a spleen examination and the vaccinal condition.
- (2) The Sanitary condition of the housing accommodation and surroundings.
- (3) The method of refuse collection and disposal.
- (4) The latrine accommodation and night-soil disposal.
- (5) The water supply.
- (6) Anti-malarial measures.
- (7) The inspection of the hospital, if any, including the checking of equipment.
- (8) The housing of animals, such as cattle, goats, etc.
- (9) The provision of vegetable and fruit gardens for the labourers.
- (10) The arrangements for the care and removal to hospital of sick labourers and their dependants.
- (11) The provision of private medical services for the estate.

The number of private and group hospitals functioning at the end of 1931 was 146 as compared with 162 in 1930.

The distribution of these hospitals by State was as follows : Perak 49, Selangor 51, Negri Sembilan 34, Pahang 12.

One new private hospital was opened during the year in the Ulu Selangor district, so that the number of hospitals closing down in the Federation in 1931 was 15.

During the year every effort was made to preserve the framework of schemes under the Health Boards Enactment for visiting by private medical practitioners but owing to the severe economic depression in the industry progress was difficult, and it was necessary from time to time to modify "schemes" and the "recommendations" for hospital services consequent upon frequent alterations among labour forces on estates.

At the end of the year there were three Health Board Medical Officers in the State of Negri Sembilan, the services of two others having been terminated during the year.

7.—MINE SANITATION.

The mining population, which is mainly composed of Chinese labourers showed a reduction of 23,367 during the year, i.e., from 80,528 to 57,161.

In Perak alone, the number of mining coolies, all nationalities, fell from 42,873 to 33,486.

There is also to be recorded a loss of 32,301 Chinese on account of repatriations by Government and in addition immigration from China was largely suspended throughout the year. The figure was estimated at 9,446 only.

Undoubtedly a large number of the repatriations were mining labourers as the reduction in estate population was almost entirely among Indians.

One hundred and four visits were paid to mines during the year by Health Officers and their staffs.

Inspections were made, mainly for the purpose of investigation and supervision of anti-malarial work, as the powers of securing improvements in general sanitary conditions are much restricted.

Some mine managements retain the services of visiting medical practitioners, and in a few instances of dressers, but there are many which do not.

As mines do not submit monthly health returns like estates, it is not possible to record health statistics among mining labourers.

Where mines come within the limits of Sanitary Board areas they are subject to the control of the local sanitary authority.

Returns from Government hospitals show a preponderance of sickness, especially of respiratory diseases occurring in mining districts.

The housing of labourers on the majority of mines is not satisfactory, as a rule, consisting of very temporary and insanitary structures: night-soil disposal usually consists of open platforms over ditches or streams, or open pits: there is very little attempt at collection and disposal of refuse: the surroundings are ineffectively drained: lastly the water supply is mostly derived from unprotected wells.

During the year special efforts were made to improve the health conditions on the mines.

A tour was made of the mines in Kinta by a Chinese lecturer lent by the Public Health Education Committee together with an anti-tuberculosis film with titles in Chinese character. Eighteen mines were visited and about 7,600 mining coolies saw the film. Demonstrations were also given at several mines in Selangor during the year.

8.—RAILWAY SANITATION.

Health conditions on the Federated Malay States Railways (and along open lines connected with the system in the Straits Settlements) were maintained by a Health Officer with a staff of 19 Dressers, three Health Inspectors, three Anti-Malarial Inspectors, and one Mosquito Collector.

The work is carried out in close co-operation with Health Officers in Sanitary Board areas traversed by the Railways, and also in rural areas, to protect gang lines, and to adjust conditions along the railway track which may adversely affect the health of nearby estates.

In his Annual Report for the period under review, the Health Officer, Railways, records:

- (a) two cases of smallpox in Railway quarters at Bukit Mertajam towards the end of September;
- (b) an increase of cases of dysentery and diarrhoea, two districts, Gua Musang and the Central Workshops alone contributing 78 per cent. of the total cases;
- (c) an improvement on the number of complaints of mosquito nuisance in night mail trains, due no doubt, to a great extent to the nightly spraying which was carried out at Singapore, Kuala Lumpur, Prai and Parit Buntar.

9.—SCHOOL HYGIENE.

School medical inspection was carried out by Health Officers, and by two Lady Medical Inspectors of Schools during part of the year.

The number of visits to schools fell from 1,692 in 1930 to 1,315 in 1931.

In July the two posts of Lady Medical Inspector were abolished along with that of the Assistant Health Officers for schools in Selangor.

In addition to the routine medical examination of schools, school buildings are inspected for sanitary defects which form the subject of separate reports.

The results of examination are recorded, defects noted on separate cards, and the children receive treatment when the travelling dispensary calls in the case of schools in rural areas.

Propaganda, in the form of lectures on hygiene, is associated with the routine examinations. Reference is made on this subject in paragraph 13 of this report.

TABLE XV (a).

1. Number of schools inspected	...	...	1,013
2. „ visits to schools	...	...	1,315
3. „ scholars examined	...	...	51,518

The table below gives a summary of conditions found at all schools visited:

TABLE XV (b).

PERCENTAGE OF DEFECTS SEEN AT VISITS.

		Perak.		Selangor.		Negri Sembilan.		Pahang.
Dental disease	...	36.8	...	53.4	...	26.7	...	27.2
Skin diseases	...	1.8	...	7.9	...	3.3	...	11.9
Eye defects	...	0.7	...	3.8	...	8.3	...	2.2
Spleen enlargement	...	4.4	...	4.5	...	10.6	...	15.8
Pediculosis	...	29.9	...	2.1	...	*	...	0.2

* Not recorded.

The Senior Health Officer, Perak, reports :

“The main features of interest are to be found in the high percentage of attendance at visit, the relatively low percentage of carious teeth and the absence of need for vaccination in the English schools, the high spleen rate, the large number needing vaccination and the relatively large number of boys with ear disease in the Malay schools, the high percentage of carious teeth and low percentage of eye disease in the Chinese schools, and the high percentage of pediculosis capitis and glandular enlargement in the Tamil schools. The outstanding points noted in the girls' schools were : the prevalence of head lice infection in no less than 62.4 per cent. in Malay and 44.3 per cent. in Tamil schools, but absent in Chinese and amounting to 3.2 per cent. in English schools. Caries of teeth is high in all schools varying from 45.8 per cent. in Malay girls to 65.4 per cent. in Tamils. It is also noteworthy that the spleen rate in Chinese girls is given as nil.”

The difference in figures seen for pediculosis capitis in the table is largely accounted for by the difference in the total of girls' schools visited where pediculosis predominates.

The remarks of the Senior Health Officer, Perak, apply generally to the other States.

The following tables give a summary of the work of the Dental Surgeon at schools and Infant Welfare Centres in 1931 :

WORK CARRIED OUT AT SCHOOLS IN 1931.

Patients treated.	Attendances.	Fillings.	Extractions.	Scalings.	Dressings.	Gas cases.
1,526	2,375	1,016	2,590	144	428	495

WORK CARRIED OUT AT INFANT WELFARE CENTRES IN 1931.

Patients treated.	Attendances.	Fillings.	Extractions.	Scalings.	Dressings.	Gas cases.
1,253	1,292	28	3,479	2	43	766

The Dental Surgeon reports :

“Special attention was given during the year to children of pre-school age, as it is considered that much of the dental disease seen in schools can be prevented in this manner. Of the people examined, the prevailing condition was a generalized inflammation of the mouth coupled with a copious deposit of soft tartar. This condition existed in 95 per cent. of the patients examined, and was present in patients of all nationalities and at all ages.”

10.—LABOUR CONDITIONS.

(i)—On Estates.

The distribution of labour on estates of from twenty-five acres and upwards is given in Table XVI. The estate population figures seen in the table represent the averages of the monthly totals during the year. On this basis it will be evident that the average number of labourers employed on estates throughout the year shewed a reduction of 42,378 on that for the previous year.

The corresponding figure for 1930 was only 5,578.

Taking the estate population of all nationalities the figure shows a decrease of 47,368, which is 4,990 more than for estates labourers only, and this latter figure represents the reduction in the dependant population.

The death-rate for the total estate population has fallen from 20.6 per mille in 1930 to 15.8 per mille in 1931, and the rate for labourers of all nationalities from 10.6 per mille to 7.8 per mille and for Indian labourers from 11.9 to 9.3.

The malaria death-rate also shows a fall in all sections varying from 1.1 per mille for the total estate population to 1.7 per mille for the Indian estate population including dependants.

It must again be remembered and emphasized, however, that when comparing the figures for 1930, 1931 set out in Table XVII given below, the reduction in labour gangs during the year was effected largely by repatriation of the unhealthy and sickly employees in the first instance, and that this improved state of health can hardly be maintained.

TABLE XVI.

District.	Average labour force.	No. of deaths.	Death-rate per mille.
Perak—			
Krian	7,301	35	4.8
Selama	1,925	7	3.6
Larut and Matang ...	5,712	42	7.4
Upper Perak	399	5	12.5
Kuala Kangsar	7,584	76	10.0
Kinta	7,222	47	6.5
Batang Padang	8,557	40	4.7
Lower Perak	10,873	66	6.1
Sitiawan	3,148	8	2.5
Selangor—			
Kuala Lumpur	6,962	51	7.3
Ulu Selangor	10,165	95	9.3
Ulu Langat	6,556	25	3.8
Klang	12,365	73	5.9
Kuala Selangor	11,944	88	7.4
Sabak Bernam	1,487	5	3.4
Kuala Langat	7,997	47	5.9

TABLE XVI—(cont.)

District.		Average labour force.		No. of deaths.		Death-rate per mille.
Negri Sembilan—						
Seremban	...	12,722	...	105	...	8.2
Tampin	...	8,459	...	102	...	12.0
Kuala Pilah	...	12,452	...	153	...	12.2
Port Dickson	...	9,094	...	76	...	8.3
Jelebu	...	1,000	...	5	...	5.0
Pahang—						
Kuala Lipis	...	2,730	...	45	...	16.4
Raub	...	1,127	...	16	...	14.2
Bentong	...	2,117	...	21	...	9.9
Temerloh	...	2,258	...	14	...	6.2
Kuantan	...	2,499	...	41	...	16.4
Pekan	...	42	...	—	...	—
Total	...	164,697	...	1,288	...	* 7.7

TABLE XVII.

	1930.		1931.		Increase or decrease.
1. Labour force, all nationalities	207,075	...	164,697	...	42,378
Hospital admissions	62,890	...	39,089	...	23,801
Deaths, all causes	2,189	...	1,288	...	901
Death-rate per mille	10.6	...	7.8	...	2.8
Hospital admissions, malaria only	21,068	...	8,015	...	13,053
Deaths, malaria only	497	...	177	...	320
Death-rate, malaria only	2.4	...	1.1	...	1.3
2. Estate population, all nationalities including dependants	280,721	...	233,353	...	47,368
Hospital admissions	84,581	...	54,683	...	29,898
Deaths, all causes	5,784	...	3,676	...	2,108
Death-rate per mille	20.6	...	15.8	...	4.8
Hospital admissions, malaria only	25,744	...	10,358	...	15,386
Deaths, malaria only	782	...	326	...	456
Death-rate, malaria only	2.8	...	1.4	...	1.4
3. Labour force, Indians only	157,706	...	119,173	...	38,533
Hospital admissions	55,123	...	34,704	...	20,419
Deaths, all causes	1,873	...	1,109	...	764
Death-rate per mille	11.9	...	9.3	...	2.6
Hospital admissions, malaria only	18,602	...	7,116	...	11,486
Deaths, malaria only	413	...	158	...	255
Death-rate, malaria only	2.6	...	1.3	...	1.3
4. Estate population, Indians only including dependants	225,983	...	180,789	...	45,194
Hospital admissions	76,266	...	49,206	...	27,060
Deaths, all causes	5,323	...	3,354	...	1,969
Death-rate per mille	23.6	...	18.6	...	5.0
Hospital admissions, malaria only	22,522	...	9,343	...	13,179
Deaths, malaria only	680	...	301	...	379
Death-rate, malaria only	3.0	...	1.7	...	1.3

Thus the actual vital statistics for estates in 1931 assume a favourable light.

* As compared with 10.6 in 1930.

An inspection of Table XVI shows that the average death-rate among labourers for 1931 in Pahang is 12.7, compared with 10.1 in Negri Sembilan, 6.9 in Selangor, and 6.2 in Perak.

The following comparative table shows the marked reduction in the rate for all States especially Negri Sembilan:

TABLE XVIII.

				Average death-rate among labourers.		
				1930.		1931.
Perak	...	...	...	8.1	...	6.2
Selangor	...	...	...	9.1	...	6.9
Negri Sembilan	...	...	...	14.9	...	10.1
Pahang	...	...	...	14.5	...	12.7

Once again the most unhealthy areas are to be found in Kuala Lipis district of Pahang (death-rate 16.4) and in the Kuala Pilah district of Negri Sembilan (death-rate 12.2). In both cases, the countryside is very hilly and favourable to the breeding of *A. maculatus*.

TABLE XIX.

State.				Labour force, all nationalities.		
				1930.		1931.
Perak	...	...	...	50,876	...	33,486
Selangor	...	...	...	23,288	...	18,990
Negri Sembilan	...	...	...	1,523	...	1,252
Pahang	...	...	...	4,841	...	3,433
Total				80,528	...	57,161

(ii)—On Mines.

The above tables show a reduction of 23,367 in the number of mining coolies for the year 1931.

As mine managers do not furnish monthly health returns the data regarding the health of mining labourers is scanty.

Returns from the Government hospitals, however, show a large number of admissions from mining districts: many of these are cases of a serious nature, and are no doubt largely responsible for the high case mortality rate in certain hospitals.

(iii)—In Government Departments.

“Lines” occupied by labourers of the various Government departments are inspected by officers of the Health Branch, and medical examination of the occupants carried out in addition to inspections of health conditions generally.

Where possible these lines are protected by anti-malarial measures, and out-patients treatment is given at weekly intervals by the travelling dispensaries.

A sum of \$33,800 is estimated to be spent in 1932, on the erection and improvement of “Cooly lines”.

11.—HOUSING AND TOWN PLANNING.

Meetings of the Town Planning Committees of the principal Sanitary Boards were held regularly throughout the year at which all site plans, proposed lay-outs and zoning schemes were considered.

The Annual Report of the Town Planning Superintendent, Selangor, for 1931 indicates that the effects of the present trade depression did not begin to be much felt until towards the end of the year under review. In Kuala Lumpur a zoning map is now available and supplies a considerable demand. Zoning maps of all the larger areas of population are worthy of consideration as they are of great assistance in considering planning schemes.

A number of points in connection with housing and town planning received attention in the Federated Malay States during the year and in particular the following:

- (a) *Density of houses per acre.*—The principle of a maximum density of 12 houses per acre continued to be followed in most urban areas.
- (b) *Open spaces.*—It is now generally realised that properly distributed open spaces are essential in any modern town planning scheme as “lungs” for the town. It was suggested that 1/10 of the total area should be reserved for such open space. Concerning air spaces to individual dwellings, where living quarters are concerned, any such space already provided should not be covered in on any pretext and proper provision in conformity with the existing law should be insisted on.
- (c) Attention was paid to the sites of “kongsi” and “temporary houses”.
- (d) It was suggested that back to back coolie lines should not be permitted in future.
- (e) *Cubicles.*—This matter received special consideration in the larger towns.
- (f) And also the question of suitable types of quarters for Government officials and others was raised.

The Sanitary Board, Kuala Lumpur, agreed to recommend the adoption of certain recommendations of the Chief Health Officer, Federated Malay States, for inclusion with architects' plans.

An extensive housing scheme by Government for the artisan type of city dwelling is now nearing completion in Kuala Lumpur in addition to two other completed schemes and there is some evidence of private enterprise following this example.

Town plans were approved for Ipoh and Sitiawan in Perak and draft town plans published for Taiping, Kuala Kangsar and Teluk Anson.

Work was continued on the Tamil Settlement at Ipoh and a housing scheme started at a village just outside the town.

In addition eight lay-outs were prepared for a number of the smaller towns of Selangor and planning schemes for various places prepared.

In Pahang, the new town of Temerloh was developed and made ready for occupation during the year.

Flats made their appearance in Kuala Lumpur during the year and consisted of a row of small two-storied dwellings with a common compound. Their suitability for Europeans in the tropics is a matter of opinion.

Common lodging houses continue to thrive in the larger centres of population. The usual fault is overcrowding and this was much less noticeable during the year under review, due, no doubt, in the reduction of population in the larger towns.

12.—FOOD IN RELATION TO HEALTH AND DISEASE.

Despite legislation, by-laws, rules and regulations, foodstuffs continue to be exposed by tradesmen to contamination by dust, flies and personal handling.

(i)—Bakeries.

This question received considerable attention in the Kuala Lumpur Sanitary Board area and certain recommendations made by the Health Officer were adopted by the Board with a view to improving methods of manufacture. A report by the Health Officer clearly indicated that bakeries were housed in unsuitable premises and the methods of baking and handling the bread were not satisfactory.

It was recommended that all bakeries should be confined to a definite district wherever possible and built in future to a type plan.

(ii)—Milk.

The question of the milk supply was debated by several of the larger Sanitary Boards of the Federation during the year from two points of view:

- (a) Pasteurisation.
- (b) Inspection and control of dairies.

The present raw milk supply to the towns of the Federation can only be classed as unsatisfactory from every point of view.

In Ipoh and Kuala Lumpur there are licensed dairies where milking is done under supervision but the main bulk of the local supply comes from the small private producer.

A pasteurisation scheme submitted by the Health Officer, Kuala Lumpur, was not favourably received.

In Selangor, the Health Officers, Kuala Lumpur and Selangor East, are now co-operating in an endeavour to improve existing dairies with a view to licensing regulations.

In Taiping, a Sanitary Board Sub-committee strongly recommended the provision of a milking shed such as the Sanitary Board, Kinta, controls in Ipoh.

In the small Sanitary Board area this important question is also receiving attention and it is hoped in time to effect much improvement on the existing conditions.

(iii)—**Aerated Water Factories.**

The methods of production and the premises used by most of the aerated water factories which operate throughout this country leave much to be desired from the sanitary point of view but methods are gradually being improved and by-laws were drafted for consideration during the year.

(iv)—**Markets.**

Markets in use may be classed under two heads, namely, public and private.

(a) *Public Markets.*—In Kuala Lumpur, the Federal capital, the market question received some further consideration it having been established some time ago that the existing town market was unsuitably placed and out of date.

Work was completed on the new Ipoh market during the year and improvements and additions carried out in other small centres in Perak.

The new market at Kuala Kubu Bharu contains fly-proof meat and fish sections.

The public refrigerating-chamber for meat in use in Kuala Lumpur market has entirely justified its installation.

A sum of \$8,600 is estimated to be spent in 1932 for the removal and re-erection of the market, Tapah.

(b) *Private Markets.*—In many of the larger towns private meat markets still exist in addition to those supplied by the public authority, but fresh applications for such are not as a rule approved and the existing private markets are well supervised.

Any new private markets in Kuala Lumpur licensed during the year had to be provided with modern refrigerators and all already in existence at the time of the decision with ice-boxes of an approved pattern.

(v)—**Food Factories.**

Increased supervision was extended to such articles of food as vermicelli, soup, coffee, tahu and ice factories during the year and care is being taken that no new food factories which are not reasonably suitable are allowed to come into existence.

(vi)—**Restaurants and Eating-shops.**

A large number of these places exist in all the large Sanitary Board areas throughout the Federation and although the bigger restaurants may be said to attain a reasonable sanitary standard, the majority of the smaller are not so satisfactory. All are subject to regular inspection and attempts were made to effect

some improvements in the methods of food preparation and disposal wherever possible but attempts are made only to obtain a gradual and progressive improvement.

All new premises are required to conform to reasonable standards before licensing.

(vii)—**Piggeries.**

Action was taken during the year in some of the larger Sanitary Board areas to prohibit this trade in residential areas. In most cases animals are housed under very bad sanitary conditions with a resulting fly and mosquito nuisance and universal restriction to definite areas in residential zones is desirable.

(viii)—**Samples under the Sale of Food and Drugs Enactment.**

Apart from the question of milk samples, periodical inspections of all foodstuffs were carried out.

Over 76,000 tins of milk and 115 tins of other foodstuffs were surrendered and destroyed.

As the result of a report from Singapore, the question of "Face Powders" received attention during the year as it was found some time ago that samples of this cosmetic being sold in the towns of the Federation revealed on analysis large quantities of lead carbonate. As such powders may result in considerable injury to life and health and the existing law on the subject did not cover the sale of such articles steps were taken to alter them and a rule under the Food and Drugs Enactment prohibiting the sale of cosmetics containing lead was published in the *Gazette* during the month of February, 1931, and these are no longer stocked in Sanitary Board areas.

(ix)—**Deficiency Diseases.**

BERI-BERI.

The number of deaths reported in 1931 as due to this disease numbered 352 as against 497 in 1930 and this shows a reduction of about 30 per cent. if correction is made for the difference in population, in both instances.

The following table shows the returns from the different States :

TABLE XX.				Deaths.	
State.				1930.	1931.
Perak	...	...	...	117	62
Selangor	...	...	...	165	110
Negri Sembilan	...	...	...	118	102
Pahang	...	...	...	97	78
Total				497	352

The majority of these were from among the Chinese. The depressed condition of trade generally might have been expected to result in an increase in the number of cases.

13.—MEASURES TAKEN TO SPREAD KNOWLEDGE OF HYGIENE AND SANITATION.

During the year, propaganda lectures were given in villages, kampongs, and schools by Malay Inspectors, in Perak and Selangor.

These lectures were associated with lantern and cinematograph displays, the latter consisting of two films "Aminah" (Infant and Child Welfare) and "The Rescue of Swee Kim" (Tuberculosis) which were well attended in all districts, especially by Kinta mining coolies. In February the Che Guru Kesihatan, Malay College, Tanjong Malim, toured Perak and gave lectures on Public Health and aroused considerable interest among his hearers.

Informal talks on hygiene were given by the Lady Medical Inspectors of Schools during visits and lectures on dental hygiene were given by the Dental Surgeon in many schools.

Lectures on Venereal Disease were also given under the auspices of the Committee for Public Health Education.

Valuable teaching was given at the Welfare Centres and by Lady Medical Officers and their staffs to kampongs and villages.

Posters on various health matters were displayed in prominent positions and many pamphlets distributed throughout the districts.

The health and welfare sections at the Malayan Agri-Horticultural Show in August attracted many interested visitors.

A successful Health Week on similar lines to that organised by the Senior Health Officer, Perak, in 1930 in Kinta was held in Taiping.

A stall for exhibits of health work, including Infant and Child Welfare and anti-mosquito activities, was provided at a Chinese Flood Relief Charity Fair in Ipoh, and was visited by a large number of people.

There is now a small Public Health section exhibit in the Kuala Lumpur museum, and small exhibits have been established in many Health Offices.

14.—TRAINING OF SANITARY PERSONNEL.

Constant training of health staff is carried out.

Six Health and Sanitary Inspectors obtained the certificate of the Royal Sanitary Institute during the year, and 10 passed the probationer's test examination.

Twenty-one Dressers, 15 Mosquito Destruction Committee Volunteers, and one Overseer were given instruction and training at Health Offices in Perak and Selangor.

Health Inspectors and others received specialised training in the identification of mosquito larvæ and imagines by the courtesy of the Director of the Institute for Medical Research.

IV.—PORT HEALTH AND ADMINISTRATION.

PORT SWETTENHAM.—During the year under review 703 (comprising 2,777,767 tons) ocean-going and 683 (336,475 tons) local vessels passed through the port. Of these, 136 arriving from infected and suspected ports were boarded by the Port Health Officer.

In addition 26 ships carrying 57 immigrants and 1,680 deck passengers from the ports of Madras Presidency were boarded. Twenty-four of these ships were clean and two suspected for cholera. In the latter appropriate measures were carried out at Penang.

Three outward bound pilgrim ships, and one homeward bound pilgrim ship were boarded by the Health Officer. Five pilgrims embarked (having fulfilled regulations of Pilgrim Enactment), and 13 disembarked at Port Swettenham.

One thousand seven hundred and thirty-seven immigrants and deck passengers were admitted into the Quarantine Camp, Port Swettenham, where they underwent the usual segregation during which period they had their clothes and belongings disinfected, and were bathed, and some 1,670 were vaccinated against smallpox. Of these 1,737, 57 were State aided.

Comparative figures for the past three years are as follows :

	1929.	1930.	1931.
Remaining in Camp from preceding years	25	624	—
Admitted	56,001	27,915	18,715*
Total	56,026	28,539	18,715
Discharged to Dépôt	55,077	28,494	57
Transferred	153	14	—
Absconded	21	2	—
Died	151	29	—
Remaining in Camp on 31st December	624	—	—

The largest number of immigrants dealt with on one day was only seven while the daily average number in Camp amounted to 1.06.

The reduction in immigrants which was the result of the depressed conditions in the industry and suspended immigration will be noted.

On the other hand a tide of emigration set in and a large portion of the accommodation at the Quarantine Camp was placed at the disposal of the Labour Department for repatriation purposes. Between August and beginning of September 12,819 Indian emigrants passed through the Camp on the way to India.

* Includes 18,658 Indians repatriated from Selangor during 1931.

No infectious diseases were recorded here.

The following is a list of the more important diseases encountered and the case mortality in each case:

	Cases.	Deaths.	Percentage mortality on total treated cases.
Malaria	143	3	2.1
Bac. dysentery	3	1	33.
Phthisis	10	5	50.
Anaemias	62	6	9.7
Broncho pneumonia	55	17	30.9
Lobar pneumonia	29	11	38.0

There were seven births in the Camp.

The daily average number of patients in hospital was 16.28 and the largest total 169.

Buildings.—A new latrine of two compartments was erected behind the office.

Hospital.—The common latrine for wards No. 1 and 2 was divided into two with provision of accommodation for bathing. Drains and cement work were relaid and the mortuary, dhoby-house and store were repainted. Many of the smaller buildings attached to the Camp were newly painted and several minor repairs were done all over the Camp.

The construction of the new jetty in Sungei Aur is still in hand and is expected to be completed shortly.

Cholera Wards.—The fly-proofing of one block in the cholera wards was renewed.

Enclosures for women's bathing place were made in all the inner circle huts and showers were provided in all bathing places, and extensive repairs and renewals were carried out to the corrugated iron walls and cement works in the inner circle huts and all the huts were repainted, other minor works were also completed.

Bills of Health.—Bills of health to a total of 77 were issued on demand at Port Swettenham and 321 passenger undertakings.

PAHANG.—The Port of Kuantan.—The port had a clean bill of health during the year. There was 100 calls by steamers but in no instance was any of these found to be infected.

PERAK.—There are two ports in the State of Perak, viz., Port Weld and Teluk Anson (including Bagan Datoh) and inspection of ships is only carried out when cases of suspected infectious disease are reported. No such case was reported during the year. No return of shipping is available.

V.—MATERNITY AND CHILD WELFARE.

Six welfare centres were maintained during the year. These were sited at Kuala Lumpur, Klang, Taiping, Ipoh, Seremban and Teluk Anson.

The new Infant Welfare Centre at Taiping was opened at the beginning of February when it was transferred from the shop-house premises previously rented.

The Centre at Teluk Anson which was opened in October, 1930, justified its establishment as the attendances during 1931 were 7,781 more than in 1930, and this in spite of the fact that no bus is employed at this Centre.

During the year committees of voluntary workers were started and some 22 workers were of great assistance to the different Centres at Kuala Lumpur, Ipoh, Taiping, Seremban and Klang.

Every endeavour was made to confine the work of Centres to Infant and Child Welfare Work but still a number of other persons, who are mostly parents of infants, have to be treated at these Centres.

Help and advice were again given to qualified midwives during the year and inspections of midwifery bags carried out at fortnightly intervals, with the added object of bringing to the Centre for examination prospective mothers who had retained the midwives services for confinements.

A feature of this year's work has been the increasing numbers of expectant mothers who have attended the Centres.

The mothers in addition received dental advice and treatment from the Dental Surgeon, Federated Malay States, who attends the Centres at periodical intervals.

The Infant and Child Welfare Exhibition which formed a part of the Malayan Horti-Agricultural Exhibition, during the 1st week of August, 1931, attracted many visitors to the demonstrations.

A film entitled "Aminah" which deals with the working of Infant and Child Welfare Centres was exhibited at many schools, kampongs, villages, etc., during the year and created much interest.

The Taiping Health Week attracted many persons to the Infant Welfare Exhibit and in Ipoh, at a Chinese "Fair", the Infant Welfare stall was well attended.

The following table indicates the popularity of the Centres:

Centres.		TABLE XXI.					Number of attendances.
Kuala Lumpur		...	...	...	...	...	32,412
Klang	...	...	...	...	...	...	26,266
Taiping	...	...	...	...	...	...	22,971
Ipoh	...	...	...	...	...	...	30,772
Seremban	...	...	...	...	...	...	39,071
Teluk Anson	...	...	...	...	...	...	18,500
		Total					<u>169,992</u>

This figure represents an increase of 26,523 attendances over 1930, Seremban and Teluk Anson alone contributing 24,686, of the total.

The system of recording attendances during the year was similar to that employed in 1930.

The motor-buses attached to the Centres were responsible for conveying some 63,381 mothers, babies and children to and from the Centres, and the total mileage incurred in this service was 45,744, a reduction of 8,306 miles as compared with 1930.

A list of the more important conditions in infants and young children who were seen at the Centres includes the following :

- Malaria;
- Skin diseases of infancy;
- Bronchitis and pneumonia;
- Dyspepsia;
- Hypothrepsia;
- Anæmia;
- Acute gastro-enteritis;
- Whooping cough;
- Affection of the ears;
- Affection of the eyes;
- Stomatitis;
- Diseases of the umbilicus;
- Diphtheria;
- Measles;
- Ophthalmia neonatorum;
- Tetanus neonatorum.

The number of malaria cases was 2,889 or 1.7 per cent. of the total attendances.

GENERAL.

This report connotes the abolition of the post of Chief Health Officer, Federated Malay States. This post was created at the beginning of 1911 and the first holder was Dr. S. H. R. Lucy.

He was succeeded in 1919 by Dr. A. R. Wellington, who held the post until January, 1929, when he was transferred to Hongkong as Director of Medical and Sanitary Services. At the time he left Dr. Wellington saw some of his ambition realized in that a proper health establishment had been created and health work and propaganda had attained a definite and increasing status in the life of the country.

Dr. P. S. Selwyn-Clarke, who came from West Africa in February, 1930, carried on the post. He assiduously attempted progress in many directions but will be especially remembered for what he did to co-ordinate and standardize work in the different States and for the high standard of work that he invariably set.

9th March, 1932.

A. G. H. SMART,
Chief Health Officer, F.M.S.

VI.—HOSPITALS, DISPENSARIES AND SPECIAL CLINICS.

(1)—HOSPITAL IN-PATIENTS.

The following table shows the hospitals maintained by the Medical Department, the average daily number of patients in each, the total number of patients admitted during the year, the total number of deaths, and the death-rate per hundred admissions:

Hospitals.	Average daily No. of patients.	Total No. of patients admitted.	Deaths	Deaths per hundred admissions.
I.—PERAK.				
Ipoh, District	450	10,632	880	8.27
Taiping, General	123	2,961	274	9.25
„ District	258	4,109	303	7.37
Batu Gajah	168	3,655	305	8.34
Kuala Kangsar, District ...	184	2,312	143	6.14
„ „ Women's	75	1,668	103	6.17
„ „ Malay	30	717	15	2.09
Teluk Anson, General ...	152	4,269	315	7.37
Kampar, District	232	3,664	391	10.67
Tapah, District	162	2,926	185	6.32
Parit Buntar, District ...	84	2,050	131	6.39
Tanjong Malim, District ...	51	1,522	81	5.32
Sitiawan, District	53	2,376	125	5.26
Sungkai, District	34	950	47	4.94
Grik, District	16	411	24	5.84
Klian Intan, District ...	22	520	52	10.00
II.—SELANGOR.				
Kuala Lumpur, Bungsar ...	17	505	8	1.58
„ „ Tanglin	121	3,771	258	6.84
„ „ District	623	8,342	1,028	12.32
„ „ Malay	73	1,645	43	2.61
Klang, District	158	4,041	364	9.00
Kajang, District	115	2,340	192	8.20
Kuala Kubu, District ...	68	1,200	161	13.41
Serendah, District	79	1,723	112	6.50
Kuala Selangor, District ...	20	647	48	7.42
III.—NEGRI SEMBILAN.				
Seremban, 1st Class A Wards	7	189	3	1.58
„ General	312	6,432	517	8.03
Kuala Pilah, District ...	212	3,110	222	7.13
„ Women's	70	1,246	138	11.04
Tampin, District	103	1,902	167	8.78
Port Dickson, District ...	74	833	98	11.76*
Jejebu, District	33	734	45	6.11

*NOTE.—Tuberculosis cases are transferred to this hospital.

Hospitals.		Average daily No. of patients.		Total No. of patients admitted.		Deaths.		Deaths per hundred admissions.
IV.—PAHANG.								
Kuala Lipis, General	...	98	...	2,350	...	150	...	6.38
Kuantan, General	...	136	...	2,251	...	159	...	7.06
Bentong, District	...	103	...	2,017	...	165	...	8.18
Raub, District	...	65	...	1,395	...	116	...	8.31
Mentakab, District	...	42	...	1,053	...	60	...	5.69
Pekan, District	...	25	...	439	...	10	...	2.27
Kuala Rompin	...	1	...	30	...	3	...	10.00

The preceding table excludes the cases in gaol hospitals and criminal vagrant wards (*vide* section VIII), which are, however, included in the return of diseases, Tables III and IV, page 71 and page 82.

Many patients were transferred from one hospital to another for special treatment; each patient transferred has been recorded as one case only in Table III, which is an exact return of the total number of in-patients in Government hospitals.

The total number of in-patients admitted during 1931 was 92,806 with 7,452 deaths. The corresponding figures for 1930 were 115,886 patients, with 9,826 deaths.

The distribution in the four States was as under:

				Admissions.		Deaths.
Perak	...	...	...	44,383	...	3,386
Selangor	...	...	...	24,338	...	2,217
Negri Sembilan	...	...	...	14,558	...	1,190
Pahang	...	...	...	9,527	...	663

The existing hospital accommodation at the end of the year, and the average daily number of in-patients during the year, in the four States is shown hereunder:

		Total number of beds.		Average daily number of patients.	
		1930.	1931.	1930.	1931.
Perak	...	3,010	3,145	2,375	2,105
Selangor	...	1,926	1,729	1,515	1,280
Negri Sembilan	...	1,121	1,151	962	814
Pahang	...	599	628	485	472

The great falling off in the number of patients under treatment in Government hospitals during the year may be attributed to two causes. The first of these was the repatriation on a wholesale scale of both Indians and Chinese, which was taking place throughout the year as the result of depression in the rubber and tin industries: as a result there was not only a great reduction in the general labour forces, but more particularly there were repatriated very many weakly and decrepit persons, who normally swell the number of hospital admissions. The other cause of the lower figures was the fact that malaria was even less in evidence during 1931 than in 1929 and 1930, which in turn were healthy years compared with the previous period.

Table III (page 71) sets out the full return of all cases treated as in-patients. As a ready indication of the comparative incidence of those diseases or groups of diseases which were responsible for a large number of admissions, the following summary is here included:

PREVAILING DISEASES AMONG HOSPITAL PATIENTS.

Diseases.		Admissions.		Deaths.		Mortality.	
Malaria, acute	19,722	...	916	...	4.64
„ chronic	3,169	...	149	...	4.70
Venereal disease	4,640	...	76	...	1.64
Influenza	5,775	...	25	...	.43
Chest Affections—							
Bronchitis	2,787	...	69	...	2.48
Pneumonia and broncho-							
pneumonia	2,392	...	1,068	...	44.64
Pulmonary tuberculosis	2,179	...	975	...	44.74
Intestinal Affections—							
Dysentery	1,923	...	391	...	20.33
Diarrhoea and enteritis	1,773	...	259	...	14.60
Other Affections—							
Helminthic diseases	2,402	...	18	...	.74
Beri-beri	1,036	...	105	...	10.13
Anæmia	1,144	...	289	...	25.26
Surgical Conditions—							
Chronic ulcers	4,438	...	17	...	.38
Wounds	4,338	...	73	...	1.68
Fractures, etc.	3,003	...	87	...	2.89
Abscesses, etc.	2,777	...	79	...	2.84

NOTES ON PREVAILING DISEASES AMONG HOSPITAL PATIENTS.

(i) *Malaria*.—This, of course, heads the list of prevailing diseases, both as regards the number of cases admitted and the number of deaths.

The figures of admissions for the last five years are as under:

1927	...	...	...	...	...	48,927
1928	...	...	...	...	...	49,553
1929	...	...	...	...	...	35,306
1930	...	...	...	...	...	36,647
1931	...	...	...	...	...	22,901

Out of the total of 22,901 patients diagnosed as suffering from malaria, the diagnosis was confirmed by microscopic examination in 15,983 and the specific infections were as follows:

Sub-tertian infection	...	9,529	or 59.61 per cent.
Tertian infection	...	5,010	„ 31.34 „
Quartan infection	...	745	„ 4.66 „
Mixed infection	...	699	„ 4.37 „

There were 25 cases of blackwater fever admitted to hospital with seven deaths.

The number of admissions for malaria in the four States for the last two years was as follows:

States.	1930.			1931.		
	Acute.	Chronic.	Total.	Acute.	Chronic.	Total.
Perak	12,913	1,596	14,509	10,514	1,241	11,755
Selangor	8,100	1,719	9,819	3,922	810	4,732
Negri Sembilan	7,404	536	7,940	3,061	383	3,444
Pahang	3,726	653	4,379	2,235	735	2,970

Malaria admissions for each of the twelve months of the year in the hospitals of the four States are shown in the following table:

Months.	Perak.	Selangor.	Negri Sembilan.	Pahang.	Total.
January	949	437	324	213	1,923
February	718	355	225	148	1,446
March	797	359	223	191	1,570
April	848	359	284	251	1,742
May	1,370	635	453	415	2,873
June	1,448	643	403	304	2,798
July	1,233	497	385	329	2,444
August	1,036	357	270	222	1,885
September	992	291	243	232	1,758
October	827	263	222	205	1,517
November	759	262	232	272	1,525
December	778	274	180	188	1,420

Further information on the seasonal incidence of malaria is included in section III of this report. Racial incidence among hospital patients is shown in the table on page 46.

(ii) *Venereal Disease*.—This subject is dealt with in Appendix III.

(iii) *Pneumonia*.—The number of cases diagnosed as pneumonia or broncho-pneumonia was 2,392, of which 1,068 were fatal; the case-mortality was therefore 44.64 per cent.

(iv) *Pulmonary Tuberculosis*.—The number of admissions to hospital was 2,179, compared with 2,109 during the previous year. The case-mortality was 44.74 per cent. The recorded deaths from pulmonary tuberculosis in Government hospitals during the last ten years are as follows:

1922	1,062
1923	1,006
1924	1,037
1925	1,051
1926	995
1927	1,118
1928	1,074
1929	1,078
1930	1,061
1931	975

Attention has been called in previous Annual Reports to the lack of evidence to justify the opinion that the incidence of pulmonary tuberculosis is increasing. The hospital figures for 1931, as well as the returns of the Registrar-General of Births

and Deaths, might suggest a recent improvement; but this apparent improvement cannot be dissociated from the recent repatriation of large numbers of poorer Chinese and Indians, amongst whom tuberculosis is comparatively frequent.

(v) *Dysentery*.—The number of patients recorded under “dysentery” was 1,923, and the number of deaths was 391. In addition to cases recorded as dysentery, there were 1,773 recorded as diarrhoea or colitis, with 259 deaths. If the records under the different, though related, headings are combined, the figure for the year are 3,696 admissions with 650 deaths, compared with 5,327 admissions and 1,036 deaths in 1930.

(vi) *Beri-beri*.—The number of cases recorded as beri-beri was 1,036, compared with 1,844 in 1930. In last year’s report a slight increase was noted, and the explanation was offered that it might be due to “economic conditions interfering with the proper nourishment of the poorer classes, the full effect of which may not be apparent as yet”. It is satisfactory to note that neither the hospital records nor the Registrar-General’s returns indicate any grave increase in the disease during 1931, although economic conditions showed no improvement. The increasing tendency of the various communities in Malaya to grow their own foodstuffs may reasonably be supposed to have assisted towards the prevention of beri-beri.

(vii) *Anaemia*.—There were 1,124 patients recorded as suffering from “anaemia”, with no indication of other pathological condition. As noted in last year’s report, many cases so recorded may be suffering from malaria, syphilis or ankylostomiasis. In addition there were recorded 39 cases of anaemia of pregnancy, with 26 deaths. Such cases have not been separately recorded in past years, although this particular pathological condition has been the subject of special study and investigation in the Government hospitals of the Federated Malay States. It cannot be said that the subject has yet been elucidated; there is still considerable difference of opinion as to the causation of the condition; but there appears to be sufficient evidence for maintaining that “anaemia of pregnancy” as it occurs amongst Indian women in Malaya is a definite clinical condition, obscure as to its causation, difficult in its treatment, and frequently fatal.

(viii) *Chronic Ulcer*.—This condition was recorded under a separate heading in the returns of diseases for the first time in last year’s report, when 6,550 cases were reported. The number recorded during 1931 was 4,438.

NOTES ON OTHER DISEASES.

(i) *Leprosy*.—The recorded number of new cases of leprosy detected and segregated during the year was 277. The number reported for 1930 was 322, and the average number for the four years previous to 1930 was estimated at 254. Leper settlements are dealt with in section VII B, page 57.

(ii) *Enteric Fever*.—The number of diagnosed cases was 315 with 91 deaths, compared with 468 cases and 117 deaths in 1930.

- (iii) *Tropical Typhus*.—The number of cases diagnosed is still increasing: 207 cases were admitted to hospital, with 24 deaths. Cases have been discovered in districts from which the disease had not previously been reported: it is difficult to say whether this indicates actual geographical spread of the infection or only more careful and successful search for the disease. The subject is dealt with in the Report of the Institute for Medical Research (Appendix I).
- (iv) *Leptospirosis*.—There were 27 cases diagnosed, with twelve deaths.
- (v) *Japanese River Fever*.—There were eight cases with four deaths, one of the fatal cases was a European.
- (vi) *Cancer*.—The number of patients in Government hospitals recorded as suffering from malignant tumour was 348, with 159 deaths. These figures approximate to those of previous years. A statement of the nature of the tumours examined microscopically will be found in the Report of the Institute for Medical Research (Appendix I).
- (vii) *Cirrhosis of the Liver*.—This was recorded as the diagnosis in 322 cases; the deaths numbered 153. The condition occurs chiefly (75 per cent.) among Chinese.

RACIAL INCIDENCE OF CERTAIN DISEASES AMONG
HOSPITAL IN-PATIENTS.

Diseases.	Chinese.		Indians.		Malays.		Others.	
	Admissions.	Deaths.	Admissions.	Deaths.	Admissions.	Deaths.	Admissions.	Deaths.
Malaria	7,841	602	13,551	435	1,136	18	353	10
Dysentery	800	199	1,840	337	142	8	70	3
Pneumonia and broncho- pneumonia	627	384	1,670	656	72	19	27	9
Pulmonary tuberculosis ...	1,222	645	791	298	126	22	40	12
Cirrhosis of liver	244	121	60	28	18	3	6	—
Chronic ulcer	2,481	13	1,385	3	528	1	46	—
Beri-beri	993	103	3	...	39	2	1	—
Appendicitis	55	7	134	8	15	1	66	—

HOSPITAL ADMISSIONS AND DEATHS, BY RACES FOR ALL DISEASES.

Race.	Admissions.		Deaths.		Case mortality per cent.		Admission rate per cent.	
Chinese ...	32,748	...	3,885	...	11.8	...	35.29	
Indians ...	49,870	...	3,297	...	6.6	...	53.73	
Malays ...	7,391	...	161	...	2.1	...	7.97	
Others ...	2,797	...	109	...	3.8	...	3.01	
Total ...	92,806	...	7,452	...	8.02	...	100.00	

The explanation of the higher mortality among Chinese patients, as shown above, is to be found in the comparative reluctance of the Chinese to enter hospital until disease is far advanced.

(2)—OUT-PATIENTS.

The total number of out-patients treated during the year is recorded as 644,065. This comprises those treated at all Government hospitals and dispensaries, including travelling dispensaries, as well as patients visited in their own homes: it does not include those treated at Infant Welfare Centres, or at school inspections, nor does it include attendances at special clinics, e.g., social hygiene and ophthalmic clinics, all of which are recorded elsewhere in this report.

From the figures given below it will be noticed that there is a considerable increase in the numbers treated in Perak; this increase was due to the opening of dispensaries at Bota and Pulau Tiga during the year. At these dispensaries, which are in a Malay kampong area, 13,053 Malays were treated of which 5,391 were females. This is very gratifying.

These out-patients can be classified under three headings:

	Male.	Female.	Total.
I.—At Hospitals	183,455	54,013	237,468
II.—At Stationary Dispensaries ...	162,053	43,811	205,864
III.—By Travelling Dispensaries ...	150,872	49,861	200,733
	<hr/> 496,380	<hr/> 147,685	<hr/> 644,065

The figures for the four States are shown below:

	Male.	Female.	Total.
(1)—PERAK.			
I.—At Hospitals	62,825	19,063	81,888
II.—At Stationary Dispensaries ...	73,993	20,956	94,949
III.—By Travelling Dispensaries :			
(a) Road	57,039	15,991	73,030
(b) River	672	326	998
	<hr/> 194,529	<hr/> 56,336	<hr/> 250,865

	Male.	Female.	Total.
(2)—SELANGOR.			
I.—At Hospitals	57,702	14,239	71,941
II.—At Stationary Dispensaries ...	53,271	14,342	67,613
III.—By Travelling Dispensaries ...	36,732	12,011	48,743
	<hr/> 147,705	<hr/> 40,592	<hr/> 188,297

	Male.	Female.	Total.
(3)—NEGRI SEMBILAN.			
I.—At Hospitals	23,941	6,783	30,724
II.—At Stationary Dispensaries ...	29,192	6,677	35,869
III.—By Travelling Dispensaries ...	18,259	7,045	25,304
	<hr/> 71,392	<hr/> 20,505	<hr/> 91,897

	Male.	Female.	Total.
(4)—PAHANG.			
I.—At Hospitals	38,987	13,933	52,915
II.—At Stationary Dispensaries ...	5,597	1,836	7,433
III.—By Travelling Dispensaries :			
(a) Road	23,903	9,940	33,843
(b) River	14,267	4,548	18,815
	82,754	30,252	113,006

A return of the diseases among out-patients is given in Table IV under the same main headings as those employed in the Return of Diseases for In-patients.

(3)—LABORATORY AND POST-MORTEM EXAMINATIONS
IN HOSPITALS.

1.—Laboratory.

(a).—BLOOD FILM EXAMINATIONS.

State.	Number of patients examined.	Number positive for malarial parasites.				Total number of examinations of blood films.
		Sub-tertian.	Benign tertian.	Quartan.	Mixed infection.	
Perak	55,249	7,047	3,975	259	448	94,521
Selangor	33,127	3,363	2,600	222	193	68,861
Negri Sembilan	22,305	2,593	1,364	312	119	45,784
Pahang	11,582	1,226	1,188	189	144	31,554
Total	122,263	14,229	9,127	982	904	240,720

In this table cases of mixed infection have been included also under the specific headings.

Sub-tertian malaria was again the commonest form of infection in all four States.

(b).—MICROSCOPICAL EXAMINATION OF FAECES.

State.	Number of patients examined.	Positive for Entamoeba histolytica.	Positive for ova.			Total number of examinations.
			Ascaris.	Ankylos-tome.	Mixed infection.	
Perak	50,977	591	15,191	6,196	1,964	88,320
Selangor	21,459	169	5,357	2,198	1,027	39,348
Negri Sembilan	13,560	135	2,138	1,488	358	26,734
Pahang	9,301	46	1,364	1,225	379	18,978
Total	95,297	941	24,050	11,107	3,728	173,380

(c).—POST-MORTEM EXAMINATIONS.

	Medico-Legal.	Clinical.
Perak	568	649
Selangor	322	444
Negri Sembilan	167	119
Pahang	96	34
Total	1,153	1,246

(4)—DISEASES AMONG EUROPEANS.

The figures for in-patients which follow may be taken as indicative of the incidence of serious disease among the general European population, since Government hospitals are open alike for Government servants and the general public, and no other hospitals or nursing homes are available.

In-patients.—The total number of admissions, exclusive of 90 cases of normal labour, was 1,071, and there were 21 deaths. The causes of deaths not recorded below were returned as myocarditis, embolism, haemorrhage, blackwater fever, other diseases of the heart, nephritis and infantile convulsions.

Prevailing Diseases.—

				Admissions.	Deaths.
Malaria—acute	...	...	...	179	2
Malaria—chronic	...	...	...	2	—
Tonsillitis, pharyngitis, etc.	...	...	...	44	—
Admissions for the puerperal state					
other than normal labour	...	...	...	53	—
Dysentery, etc.	...	...	...	44	—
Appendicitis	...	...	...	46	—
Wounds	...	...	...	21	1
Fractures, etc.	...	...	...	49	—

Of the malaria cases, benign tertian infection was definitely diagnosed in 89, and sub-tertian in 63. There were eleven cases of mixed infection, and only 15 acute cases in which diagnosis was not confirmed microscopically.

The high incidence of appendicitis, mentioned in previous reports, continued during the year.

Other Diseases.—

				Admissions.	Deaths.
Enteric fever	...	...	...	6	—
Tropical typhus	...	...	...	1	—
Influenza	...	...	...	71	—
Dengue	...	...	...	17	—
Pulmonary tuberculosis	...	...	...	5	1
Bronchitis	...	...	...	17	—
Pneumonia and broncho-pneumonia				1	—
Diseases of the ear	...	...	...	12	—
Diseases of the nose	...	...	...	7	—
Cancer	...	...	...	10	2
Leptospirosis	...	...	...	4	—
Japanese river fever	...	...	...	5	1
Diabetes mellitus	...	...	...	6	2
Diseases of the liver	...	...	...	17	2
Sprue	...	...	...	2	2

European Out-patients.—

States.	Male.	Female.	Total.
Perak	359	133	492
Selangor	1,474	1,033	2,507
Negri Sembilan	703	144	847
Pahang	420	157	577

The figures for out-patients refer mainly to Government servants and their families, since other European patients are usually treated by private practitioners.

(5)—SURGERY.

The following are the figures returned for surgical operations, excluding ophthalmic surgery, in all the hospitals in the four States :

	Major operations.	Minor operations
Perak	674	3,535
Selangor	710	2,509
Negri Sembilan	351	1,700
Pahang	39	782
Total	1,774	8,526

The number of major operations in the larger hospitals was as follows :

PERAK.

District Hospital, Ipoh	310
General Hospital, Taiping	37
District Hospital, Taiping	117
	154
District Hospital, Teluk Anson	65
European Hospital, Batu Gajah	16
European Wards, Taiping	6
	22

SELANGOR.

Tanglin Hospital, Kuala Lumpur	347
District Hospital, Kuala Lumpur	169
Bungsar Hospital, Kuala Lumpur	125

NEGRI SEMBILAN.

General Hospital, Seremban	318
European Hospital, Seremban	33

A classification of the major operations at the largest hospitals is given in Table V, page 83.

The surgical reports from the three States where a Surgical Specialist is stationed are summarized in the following paragraphs:

(1) *Perak*.—Mr. T. W. H. Burne, Senior Surgeon, was in charge during the whole of the year.

Comparative figures of the major operations performed in 1930 and 1931 are shown below:

	1930.	1931.
District Hospital, Ipoh ...	340	310
European Hospital, B. Gajah ...	35	16
European Wards, Taiping ...	5	6
	<hr/> 380	<hr/> 332

(2) *Selangor*.—Mr. R. M. Dannatt was in charge at Kuala Lumpur during the whole of the year.

The figures shown below record the number of major operations performed in the three hospitals in Kuala Lumpur in 1930 and 1931. The surgical work at the District Hospital is carried out by the Medical Officer in charge of that hospital.

	1930.	1931.
Tanglin Hospital ...	375	347
Bungsar Hospital ...	140	125
District Hospital ...	207	169
	<hr/> 722	<hr/> 641

(3) *Negri Sembilan*.—Dr. E. S. Lawrie was in charge until the return from leave of Mr. C. S. Wilson in April. The figures below give the return of major operations performed in Seremban.

	1930.	1931.
General Hospital, Seremban ...	252	318
European Hospital, Seremban ...	23	33
	<hr/> 275	<hr/> 351

It is gratifying to note the increased readiness with which Malays are seeking surgical relief; 32 Malays were the subjects of major operations during the year.

(6)—RADIOLOGY.

Kuala Lumpur.—Dr. C. F. Constant, Radiologist, was in charge for the whole year, and Mrs. E. St. G. Johnston acted as Lady Assistant in Electro-Therapy.

Ipoh.—Dr. Constant continued his weekly visits to Ipoh until the return of Dr. O'Grady on 3rd September, 1931.

COMPARATIVE TABLE OF WORK DONE DURING THE
LAST TWO YEARS.

		X-Ray examinations.			Treatments.		
		1930.		1931.		1930.	1931.
Kuala Lumpur	...	1,857	...	1,721	...	2,318	2,619
Ipoh	...	1,572	...	1,394	...	1,078	741
Total		3,429	...	3,115	...	3,396	3,360

In this table the X-Ray examinations represent the number of patients examined (repetitions being excluded); but the treatments refer to the total number of attendances for treatment.

In addition, a number of X-Ray examinations were made with the two portable sets in use in Perak and Selangor.

Very little radiological work was done at Seremban on account of the unreliability of the apparatus installed there. A new apparatus has now been purchased and will be in working order early next year.

(7)—OPHTHALMOLOGY.

Special clinics for diseases of the eye were in operation at the following centres :

I.—PERAK—

(a) *Ipoh Hospital*.—Dr. P. H. Hennessy, Ophthalmologist, was in charge during the whole of the year.

(b) *Taiping Hospital*.—Dr. G. Abraham, Senior Deputy Medical Officer, was in charge for the whole year.

II.—SELANGOR—

Kuala Lumpur Tanglin (late General) Hospital.—Dr. A. E. Duraisamy, Senior Deputy Medical Officer, was in charge until the return of Dr. A. Viswalingam on 15th October, 1931.

III.—NEGRI SEMBILAN—

Seremban Hospital.—The new clinic, organised in 1930, has done good work under the charge of Dr. Tara Singh, Assistant Medical Officer.

In Pahang there was no regular clinic, but officers in the larger hospitals devoted certain hours each week to out-patient ophthalmic work.

The total number of patients treated in the four States was 9,420, of which 1,451 were in-patients and 7,962 out-patients (the figure records new cases, excluding repetitions and routine examinations).

TABULATED RETURNS.

			Eye diseases proper.	Eye injuries.	Refraction.	General diseases affecting eyes.	Disorganised eyes.	Total.
PERAK.								
(1) Ipoh, In-patients	...	...	380	23	3	10	24	440
„ Out-patients	...	...	2,416	177	369	28	64	3,054
(2) Taiping, In-patients	...	...	135	5	3	3	...	146
„ Out-patients	...	...	907	63	189	3	...	1,162
SELANGOR.								
(1) Kuala Lumpur, In-patients	...	...	426	41	1	10	20	498
„ Out-patients	...	...	1,444	373	339	9	15	2,180
NEGRI SEMBILAN.								
Seremban, In-patients	...	...	191	17	4	10	8	230
„ Out-patients	...	...	339	30	170	6	...	545
PAHANG.								
In-patients	...	...	132	3	...	2	1	138
Out-patients	...	...	997	15	16	...	...	1,028
Total In-patients	...	...	1,263	89	11	35	53	1,451
„ Out-patients	...	...	6,103	658	1,083	46	79	7,969
GRAND TOTAL	...	...	7,365	747	1,094	81	132	9,420

			Major operations.		Minor operations.		Subconjunctival injections.
Ipoh	...	...	146	...	193	...	—
Taiping	...	...	27	...	20	...	3
Kuala Lumpur	...	...	79	...	165	...	13
Seremban	...	...	29	...	55	...	55
Total	...	...	281	...	433	...	71

Amongst nationalities the Chinese again preponderated to an extent of over 50 per cent. A detailed account of the diseases treated, with the nationalities and sex of the patients, is appended in Table VI, with a summary of the major operations performed.

A comparison between the work done in 1930 and 1931 is set out below:

Ipoh—				1930.		1931.
In-patients	...	...	...	541	...	440
Out-patients	...	...	...	3,211	...	3,054
Taiping—						
In-patients	...	...	...	110	...	146
Out-patients	...	...	...	1,004	...	1,162
Kuala Lumpur—						
In-patients	...	...	...	768	...	498
Out-patients	...	...	...	3,223	...	2,180
Seremban—						
In-patients	...	...	...	—	...	230
Out-patients	...	...	...	—	...	545
Pahang—						
In-patients	...	...	...	—	...	138
Out-patients	...	...	...	—	...	1,028

(8)—SOCIAL HYGIENE CLINICS.

A separate report with graphs will be found in Appendix III.

(9)—WOMEN'S HOSPITALS.

The admissions to the three hospitals, at Kuala Kangsar, Kuala Pilah and Pekan, were slightly fewer than in 1930.

In addition to the treatment of in-patients, these hospitals serve as centres for medical work among women in the kampongs in the district.

The training of "bidans" (native midwives) by the Lady Medical Officer and European Sisters at Kuala Kangsar Women's Hospital for work in the kampongs has proved very successful and "bidans" have been stationed in kampongs in the Kinta and Kuala Kangsar districts; 1,295 ante-natal and 1,348 post-natal cases were treated in these districts.

The appointment of a European Sister solely for itinerant work in the kampongs in the Kuala Kangsar district has proved a success. This Sister travels by car and boat and on foot to the distant kampongs, and accomplishes a great deal of very useful work amongst the Malay population.

(10)—NEW BUILDINGS.

(1) *Kuala Kubu Bharu*.—The new hospital, which was being built on the new town created owing to the old town having to be abandoned, was completed during the year.

(2) *Kuala Lipis*.—The reconstruction of this hospital continued during the year, a forty-bed ward and operating theatre and an additional wing to the Matron's quarters were completed; work was commenced on the new administrative block.

The more important of other structural additions and alterations were as follows:

STATE OF PERAK.

Taiping.—The Infant Welfare Centre begun last year was completed and opened in February.

Kuala Kangsar.—A new two-storeyed ward was commenced, this is part of a general extension of this hospital.

STATE OF SELANGOR.

Kuala Lumpur.—District Hospital—new Labour Ward.

STATE OF NEGRI SEMBILAN.

Port Dickson.—Six-bed Isolation Ward.

STATE OF PAHANG.

Kuantan.—New ten-bed ward completed.

Pekan.—Women's Hospital: Out-patients' and administration block completed. Two-storeyed forty-bed ward commenced.

Mentakab.—Twelve-bed mosquito-proofed ward completed. New maternity block.

VII.—INSTITUTIONS FOR MENTAL DISEASES AND FOR LEPROSY.

A.—CENTRAL MENTAL HOSPITAL.

The number of patients under treatment at the end of the year was 82 less than at the beginning of the year, as the result of fewer admissions than in previous years and a greater number of discharges. This is in striking contrast with the steady large increase in the number of patients during recent years. Figures for the last three years are shown in the following tables:

	Remaining at end of 1929.			Remaining at end of 1930.			Remaining at end of 1931.		
	M.	F.	Total.	M.	F.	Total.	M.	F.	Total.
FEDERATED MALAY STATES	1,434	502	1,936	1,602	530	2,132	1,544	571	2,115
UNFEDERATED MALAY STATES.—									
Kedah	173	41	214	192	55	247	162	59	221
Kelantan	10	3	13	9	3	12	6	4	10
Perlis	13	6	19	13	6	19	11	5	16
1ST CLASS PATIENTS	1	3	4	1	3	4	...	...	...
CRIMINALS	154	4	158	170	4	174	139	5	144
Total ...	1,785	559	2,344	1,987	601	2,588	1,862	644	2,506

ADMISSIONS.

	1929.			1930.			1931.		
	M.	F.	Total.	M.	F.	Total.	M.	F.	Total.
FEDERATED MALAY STATES	631	214	845	658	193	851	553	216	769
UNFEDERATED MALAY STATES.—									
Kedah	55	11	66	54	24	78	49	21	70
Kelantan ... ..	...	...	...	...	...	...	...	1	1
Perlis	2	1	3	...	...	...	...	...	...
1ST CLASS PATIENTS	4	3	7	3	2	5	...	...	...
CRIMINALS	59	3	62	34	4	38	38	2	40
Total ...	751	232	983	749	223	972	640	240	880

Admissions by nationality are shown hereunder:

	1929.			1930.			1931.		
	Males.	Females.		Males.	Females.		Males.	Females.	
Europeans ...	1	...	...	3	...	...	...	...	...
Eurasians ...	2	...	...	3	...	2	1	...	...
Chinese ...	314	...	95	339	...	84	309	...	102
Indians ...	247	...	94	237	...	78	201	...	90
Malays ...	99	...	27	104	...	41	116	...	32
Javanese ...	10	...	13	14	...	2	8	...	10
Others ...	19	...	...	16	...	12	5	...	6

The number of admissions during the year was 92 less than during 1930. The reduction was in those suffering from confusional insanity; since this condition is the result, in most cases, of a physical illness, the reduction may be associated with the general decrease of sickness in Malaya.

The Acting Medical Superintendent reports :

“The three chief forms of insanity in the admissions are confusional insanity, melancholia and dementia praecox. These three have always been the most common. Owing to the large number of patients in the hospital and the large number of admissions yearly, it is impossible to investigate each case as much as one would wish. If this were possible I feel sure, because there is such a high incidence of toxic factors in the limited number of cases in which any history is obtained, that many of the cases diagnosed as melancholia and dementia praecox would be found to be cases of confusional insanity. Many cases of confusional insanity exhibit deep depression simulating melancholia or show almost complete apathy simulating dementia praecox, and in the absence of history or easily discoverable toxic factors these cases are diagnosed as melancholia or dementia praecox instead of confusional insanity. Dementia praecox in its true form is a most serious condition with a very poor prognosis, but it will be seen that a large number are discharged from this hospital; I do not think that such a large number can be regarded as remissions.”

“The total number of patients discharged from the hospital during the year was 747. This is 263 more than in 1930. This is almost entirely due to a great increase in the number of those discharged under the heading ‘Relieved’. With very few exceptions the discharge of a patient has been allowed when friends or relatives have requested it, as I believe recovery is often hastened in this way once the acute stage is over. Many people are left with some mental defect as the result of acute mental illness, but are still capable of earning a living if someone can look after them. It is from this class that most of the discharges as ‘Relieved’ have been made. Extensive efforts were made to trace relatives or friends who were willing to remove patients and thanks are due to the Department of Chinese Affairs, the Department of Labour and to many Penghulus for their efforts in this direction.”

“The recovery rate is 43.86 per cent. on the admissions. This is the highest rate for some years. The total number discharged as recovered was 386. The number last year was 383.”

“There were fewer deaths during the year than last year, the numbers being 188 in 1931 and 197 during 1930. The rate is 5.45 per cent. on the total treated and 7.20 per cent. on the daily average.”

“Twenty-seven patients absconded during the year which is twenty less than in the previous year.”

New Buildings.—The new buildings completed during the year were a 40-bed female ward, a minor operation theatre and two lines of attendants' quarters.

The first class wards have been closed, as the expense of maintaining them was not justified by the small number of admissions. Arrangements have been made for the treatment of first class patients in the Mental Hospital at Singapore.

The total expenditure on the hospital during the year was \$446,579.44, a decrease of \$55,907.90 on the previous year.

The Acting Medical Superintendent reports an increase in the number of Malays employed as attendants, from 5 at the beginning of the year to 42 at the end.

Dr. W. F. Samuels, the first Medical Superintendent, departed on leave prior to retirement on 20th March, after twenty years' service in charge of the hospital.

Appended is a table showing the classification of patients treated during the year.

CLASSIFICATION OF MENTAL DISEASES.

—	Remaining at end of 1930.			Admitted.			Discharged as cured.			Remaining at end of 1931.		
	M.	F.	Total.	M.	F.	Total.	M.	F.	Total.	M.	F.	Total.
A.—CONGENITAL.												
1. Intellectual—												
(a) With epilepsy ...	3	6	9	2	9	11	...	...	...	1	17	18
(b) Without epilepsy ...	60	19	79	17	8	25	...	...	...	56	18	74
2. Moral	2	...	2	2	...	2	...	...	..	...	...	...
B.—INSANITY OCCURRING LATER IN LIFE.												
1. Insanity with epilepsy	65	19	84	7	2	9	3	...	3	66	18	84
2. General paralysis of the insane	56	4	60	40	6	46	...	...	...	63	5	68
3. Insanity with gross brain lesion	4	4	8	...	2	2	...	...	...	1	...	1
4. Confusional insanity ...	243	21	264	195	29	224	168	7	175	251	58	309
5. Primary dementia ...	320	91	411	104	71	175	62	8	70	605	203	808
6. Manic Depressive—												
(a) Simple ... ..	...	...	...	5	...	5	...	...	...	...	...	...
(b) Mania	55	54	109	41	36	77	16	11	27	112	81	193
(c) Melancholia	128	92	220	126	51	177	59	15	74	262	130	392
(d) Alternating in- sanity	17	5	22	...	6	6	3	...	3	17	9	26
7. Delusional insanity—												
(a) Systematised (paranoia)	21	4	25	2	...	2	...	...	...	18	6	24
(b) Non-systematised ...	13	1	14	20	1	21	13	...	13	48	7	55
8. Post Encephalitis lethargica ... ..	...	...	...	1	...	1	...	...	...	5	...	5
9. Dementia—												
(a) Senile	133	27	160	47	14	61	13	...	13	142	42	184
(b) Secondary	865	250	1,115	24	5	29	...	...	...	215	50	265
10. Not insane	2	1	3	7	...	7	8	...	8	...	...	...
11. Under observation ...	...	3	3	...	...	...	...	...	...	...	...	...
Total ...	1,987	601	2,588	640	240	880	345	41	386	1,862	644	2,506

B.—LEPER SETTLEMENTS.

1.—Federal Leper Settlement, Kuala Lumpur.

The Leper Settlement at Sungei Buloh consists mainly of a number of small detached houses designed to accommodate two, four or six people, arranged in groups, the whole assemblage constituting a large village. Each group has its own communal bathing and sanitary building, but each house is provided with a separate kitchen, and has its own garden. The "village" is divided into four sections, allowing for four separate communities, viz., married couples, single men, single women, and Indians.

In addition to these small houses there are twelve large buildings in the form of hospital wards, each containing about twenty beds. There are many other buildings, including the administration offices, dispensary and treatment centre, and so forth. There is a school for the children, and there are two clubs.

The Settlement is lit throughout with electric light. A piped water supply is carried to every part, and there is a complete system of water flushed latrines and sewerage, with septic tank installations.

The buildings are pleasantly situated on the slopes of a hill, and the surrounding area is utilised for vegetable gardens and pig farms. The valleys and ravines around the Settlement have all been dealt with by a complete system of permanent anti-malarial drainage.

(a)—ADMINISTRATION.

Dr. G. A. Ryrie remained in charge until he proceeded on leave in July; he was succeeded by Dr. A. G. Badenoch.

(b)—STATISTICAL TABLE OF THE PATIENTS.

Nationality.	Remaining 31st Dec., 1930.	Admitted during 1931.	Died during 1931.	Remaining 31st Dec., 1931.		
				M.	F.	Total.
Chinese ...	894	208	47	641	148	789
Indians ...	174	60	22	156	31	187
Malays ...	7	4	—	5	1	6
Javanese ...	5	2	—	4	3	7
Eurasian ...	5	1	—	4	1	5
Others ...	—	2	—	1	1	2
	1,085	277	69	811	185	996

(c)—SPECIFIC TREATMENT.

Efforts were made during the year to induce the inmates to take more regular treatment. The removal of opium smokers, whose attitude to treatment was often indifferent or hostile, improved the mental tone of the Federal Leper Settlement.

Inmates have been classified (or re-classified) and arranged in treatment groups. An approach to hospitalisation of the whole Settlement has been achieved. Each inmate is seen by the Medical Superintendent at least quarterly, to be examined and encouraged and to have treatment and its effects checked and recorded. Control groups are largely a delusion. Long period of observation are necessary, and it is difficult and questionable in policy to deprive a group of treatment for many months or even a year or more. One treatment group may however be compared with another and the records that are being up will enable this to be done. The definitions and criteria suggested by the Leonard Wood Memorial Conference on Leprosy, 1931, have been adopted for general use.

Pending the outcome of these measures, a census was taken towards the end of the year and showed the following results:

Improved	...	...	...	...	...	386
Stationary	...	...	...	...	...	269
Worse	...	...	...	...	...	219
Total						874

Anti-leprol and ethyl hydnocarpate have been given up as too painful and of little proved value. Results of the main treatments in further detail are appended.

TREATMENT OF LEPRA REACTION.

Two new treatments have been introduced:

- (1) Potassium antimony tartrate, in solution, intravenously in lepra reaction proper.
- (2) Dilester, a Fiji product, intramuscularly for nerve pains and "nerve reaction".

A special investigation of treatment in relation to the calcium content of the blood serum was carried out. A report is appended.

INTRA-DERMAL INJECTIONS.

During the months of February, March, April and May, 1931, some 23 cases were given intra-dermal injections of various drugs as follows:

Iodised esters	...	...	...	...	...	18
Chaulmoogra oil	...	...	...	...	...	2
Ethyl hydnocarpate	...	...	...	...	...	1
and Ethyl chaulmoograte	...	...	...	...	...	2

Six cases were given one injection each, twelve were given two injections each, three were given three each and two were given four each.

The injected patches appeared to have much improved in ten cases, only slightly so in nine cases, and in the remaining four there was no change.

A small group was tried experimentally on several other remedies of unknown anti-leprotic value, but showed no change for the better.

TREATMENT WITH HYDNOCARPUS MEAL.

Freshly ground seeds of *H. anthelmintica* and *wightiana* are mixed with *cannabis indica* and issued daily to those for whom this treatment is prescribed. At the end of the year such patients numbered over 400.

Thirty-one thousand seven hundred and four doses were issued during the year.

The greatest number who attended regularly for this treatment over a period of one month was 205. There is room for great improvement here.

On account of irregularity in attendance no attempt was made to assess the value of this treatment.

TREATMENT WITH ALEPOL TABLETS, CONTROLLED.

In June, 1931, Messrs. Burroughs Wellcome & Co., Ltd., sent through Dr. R. G. Cochrane, Secretary, British Empire Leprosy Relief Association, a new preparation of "Alepol Tablets". These were compressed tablets made from the ethyl esters of chaulmoogra oil, of gr. 1 each for oral administration.

Dr. Cochrane's suggestion was that three groups of cases should be tried as follows:

- (A) on alepol tablets alone;
- (B) on these tablets in conjunction with intra-dermal injections of iodised esters;
- (C) on injections of iodised esters alone, given intra-dermally.

During the course, many left off treatment. Those remaining at the end of the course were as follows: A, 15 cases; B, 20 cases; C, 10 cases. All the cases except 5 in group C were of the type C1 N1.

To prevent nausea and vomiting, which were complained of during the first weeks, the tablets were given with a little soda bicarb and weak glucose solution. Only two cases stopped their treatment subsequently on this account.

The dosage was as follows:

- I—Week: One tablet on Wednesday morning, and one on Saturday morning;
- II—Week: Two tablets on Wednesday (1 a.m. and 1 p.m.) and two similarly on Saturday;
- III—Week onwards: Three tablets every Wednesday and Saturday.

After eight weeks' treatment, tablets were stopped for two weeks, but injections were continued as usual. Then tablets were given for a further eight weeks.

		Group A.		Group B.		Group C.
Number of cases treated	...	15	...	20	...	10
		—		—		—
Moderately improved	...	1	...	5	...	1
Slightly improved	...	7	...	10	...	9
No change	...	3	...	2	...	Nil
Worse after treatment	...	4	...	3	...	Nil

NOTES.—

1. The 15 A cases had treatment thus: 13 for 15 weeks, one for 14 weeks and one for 13 weeks.
2. The 20 B cases had treatment thus: tablets 15 for 15 weeks, the rest from 10 to 14 weeks. Injections—12 had 10 to 13 injections, the rest from 3 to 9 injections.
3. In almost all cases, the injected patches had improved markedly (bearing out the conclusions of most workers).
4. As noted previously, 5 of the group C cases were of the type C 2. The cases in this group were given from 6 to 10 injections.

TENTATIVE CONCLUSIONS.

1. Alepol tablets orally are likely to prove effective, but in suitable cases the dose should gradually be very much increased.

2. Alepol with intra-dermal injections seems to be a useful treatment combination.

3. Since its institution, the oral treatment has "caught on" very well, and was asked for by many other patients, so that a more extensive trial seems indicated to confirm or disprove the above findings.

GENERAL TREATMENT.

Oral sepsis, mycotic diseases, helminthic infections and syphilis are found to be prevalent. The scope of anti-syphilitic treatment is being extended; a total of 104 cases were treated during the year.

Ankylostomiasis was the subject of a special investigation and a routine treatment for all new admissions has been instituted.

A well-equipped dental clinic under the supervision of the Dental Surgeon, Federated Malay States, has been provided.

Surgery.—Twelve major and two hundred and fifteen minor operations were performed, fifty of which were amputations and 124 were for the excisions of bones from the hands and feet.

(d).—COMMUNAL LIFE.

The inmates have been peaceful and contented throughout the year. Vegetable cultivation has increased, there now being 12 acres under cultivation. Rabbit breeding has been taken up. The shops and the school continue to do well.

During the year the issue of a magazine "Dawn", reflecting life within the Settlement, was commenced. This magazine which is issued quarterly is printed and produced entirely by the inmates.

2.—Leper Asylum, Kuala Lumpur.

This asylum was re-opened in March, 1931, for the accommodation of opium-smoking lepers for all the Settlements in Malaya. A total of 502 were admitted, of these 14 were transferred and 45 died.

The majority of the inmates have no wish for anti-leprosy treatment.

The asylum is under the control of the Medical Superintendent of the Sungei Buloh Settlements.

3.—Leper Settlement for Malays, Pulau Pangkor Laut.

There were 18 admissions and 6 deaths during the year, the number remaining at the end of the year was 79, 54 males and 25 females. One case was discharged during the year.

Tai Foong Chee and Foh Mah Yean treatment was continued and injection of anti-leprol and hydnestryle were given.

The immediate control of this Settlement is under the Deputy Medical Officer, Lumut, acting under the supervision of the Senior Medical Officer, Perak.

VIII.—PRISONS, CRIMINAL VAGRANT WARDS AND
DECREPIT SETTLEMENTS.

A.—GAOL HOSPITALS AND CRIMINAL VAGRANT WARDS.

	1930.			1931.		
	Admis- sions.	Deaths.	Case mortality per cent.	Admis- sions.	Deaths.	Case mortality per cent.
PERAK.						
Taiping Gaol	158	9	5.70	237	3	1.26
Criminal Vagrant Ward, Taiping	308	12	3.90	190	9	5.00
Batu Gajah Gaol	105	4	3.80	202		
SELANGOR.						
Kuala Lumpur Gaol and Cri- minal Vagrant Ward...	161	5	3.10	124	3	2.41
NEGRI SEMBILAN.						
Seremban Gaol and Criminal Vagrant Ward... ..	173	3	1.73	112		
PAHANG.						
Kuala Lipis Gaol and Criminal Vagrant Ward	27	...	...	21		
Kuantan Gaol and Criminal Vagrant Ward	36	1	2.78	37		
Total ...	968	34	3.51	923	15	1.62

B.—DECREPIT SETTLEMENTS.

The majority of decrepits are accommodated at the Decrepit Settlement, Sungei Buloh, which is situated about three-quarters of a mile from the new Leper Settlement. It consists of 28 wards, each ward containing 24 beds, and all the wards being connected by covered passages. Other buildings include an administration block, containing offices and a dispensary, a large dining-hall, with a well-equipped kitchen, and two large workshops where the inmates can carry on their trades.

The Settlement is provided throughout with electric lighting, and a complete water supply. There are baths to every ward and water-flushed latrines, with a septic tank installation.

Administration.—Dr. G. A. Ryrie was in charge of Sungei Buloh Settlements until he proceeded on long leave in July when he was relieved by Dr. A. G. Badenoch who was in charge for the remainder of the year.

Statistical Tables :

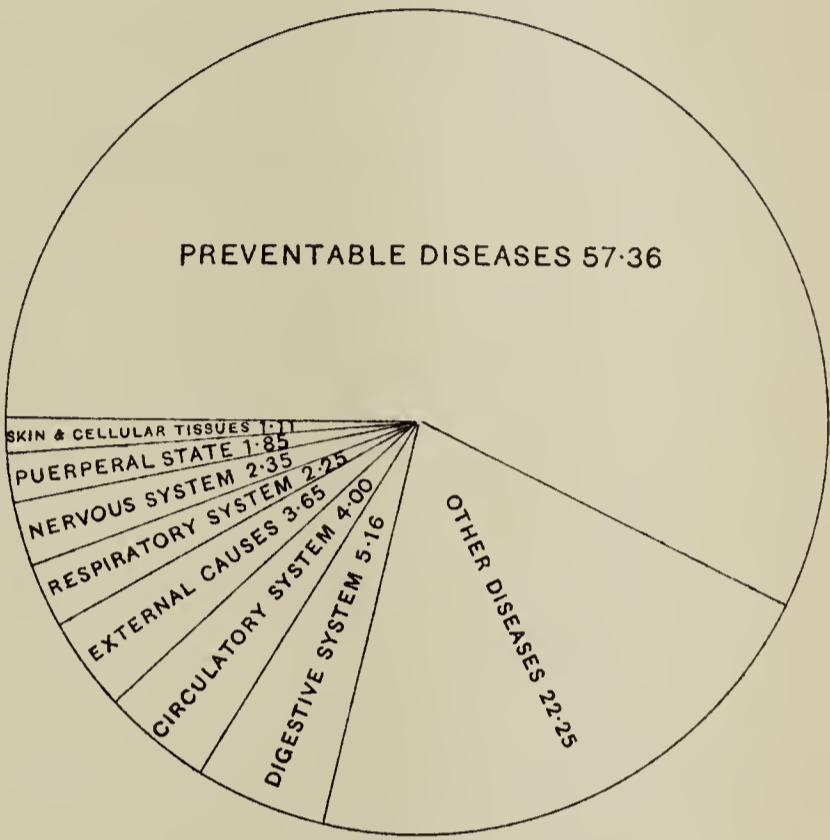
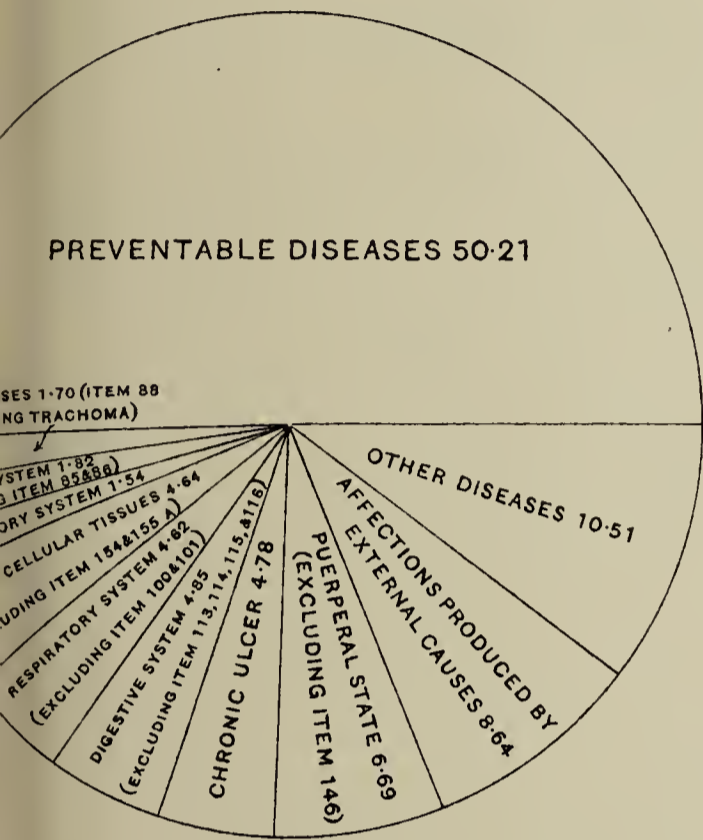
States.	Remained.	Admitted.	Discharged.	Transferred.	Absconded.	Died.	Remaining.
Perak	69	7	5	2	4	4	61
Selangor	324	322	43	29	84	32	458
Negri Sembilan	44	188	65	37	33	5	92
Pahang	5	...	3	...	2		
Total ...	442	517	116	68	123	41	611

GENERAL, SYSTEMIC AND PREVENTABLE DISEASES

(i. e. Total Cases in Government Hospitals as in Table III)

AL ADMISSIONS, 1931...92,806

TOTAL DEATHS, 1931...7,452

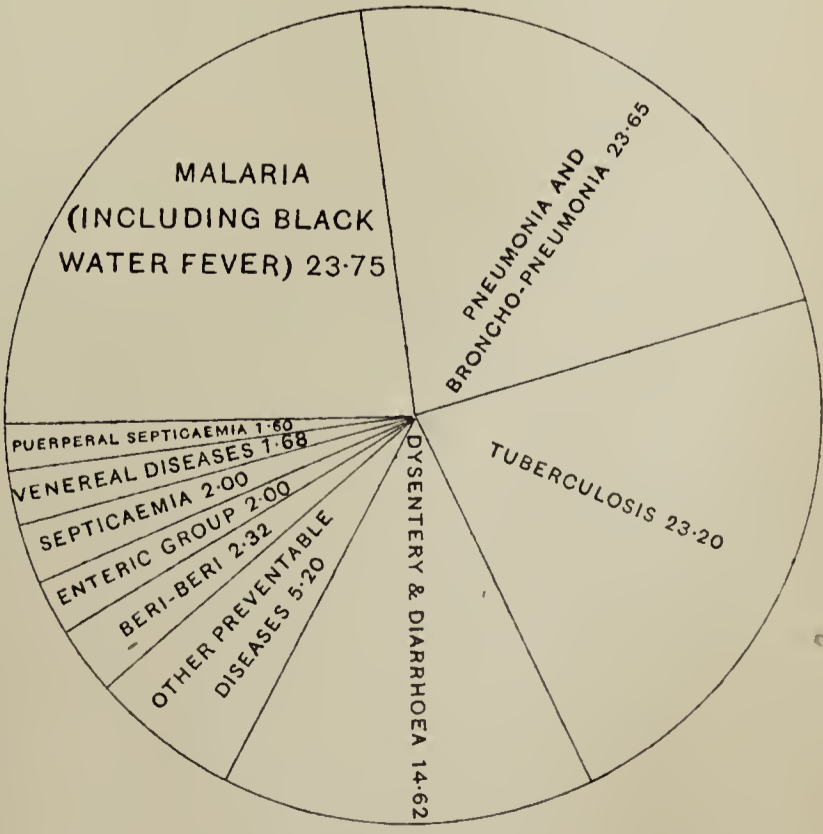
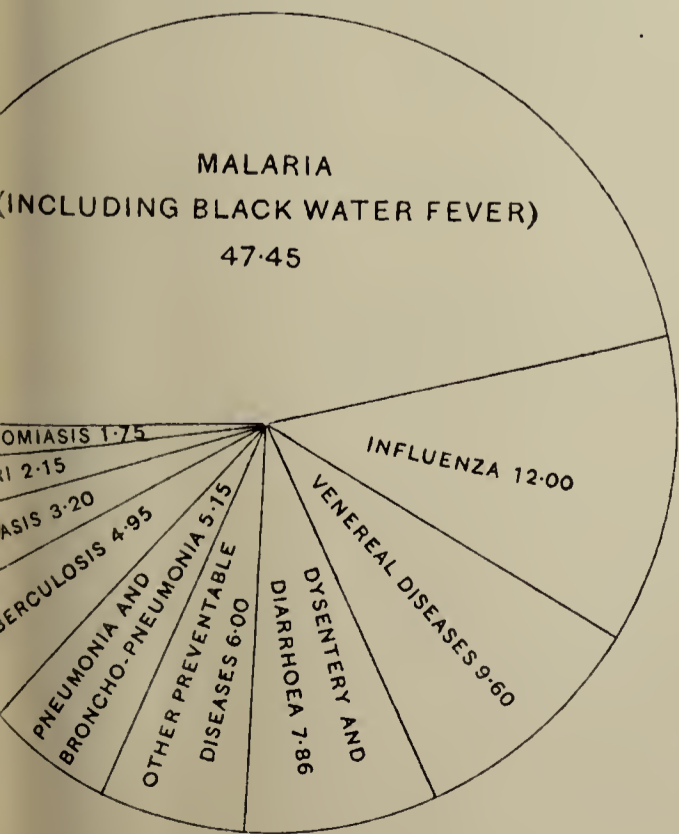


Preventable diseases are :- (a) Section I, Table III (Epidemic, Endemic, and Infectious Diseases)
(b) also in Table III Items 53, 55, 56, 66-68, 85.
(c) 100, 101, 113, 114, 115, 146, 154.

INFECTIVE AND PREVENTABLE DISEASES

ADMISSIONS, 1931...48,320

DEATHS, 1931...4,514



Discharges.—One hundred and fourteen Chinese repatriated at their own request, 1 Chinese claimed by relative, 1 Tamil discharged at request of Controller of Labour.

Transfers.—Thirty-six to Vagrant Ward, Pudu; 30 to District Hospital, Kuala Lumpur, for treatment; 2 to Federal Leper Settlement (as voluntary admissions).

General.—The health of the inmates was good, no case of serious infectious disease occurred. There were ten cases of malaria probably all imported as no malaria carrying anophelines have been detected breeding within the Settlement.

The work in which the decrepits are employed includes care of the wards and grounds, basket making, and the cultivation of vegetable gardens. Ninety-seven inmates were engaged in basket making and 25,530 baskets were sold during the year.

About four acres of land are under cultivation by inmates. Each working inmate earn from 10-20 cents per day which enables him to buy extra comforts.

The attitude of the inmates to discipline and regularity has considerably improved.

Besides the large Decrepit Settlement at Sungei Buloh there are other asylums under the supervision but not under direct control of the Medical Department. These include the Tai Wah Wards for decrepit Chinese, and the Home for Decrepit Indians, in Kuala Lumpur, and the Decrepit Wards at Taiping.

IX.—MEDICAL RESEARCH.

A full account of the work of the Institute for Medical Research, Kuala Lumpur, will be found in Appendix I of this report.

APPENDICES.

The following appendices are attached :

- (1) Report of the Director, Institute for Medical Research, Federated Malay States.
- (2) Report of the Chief Medical Officer, Social Hygiene, Federated Malay States.

CHRISTOPHER J. WILSON,
Principal Medical Officer, F.M.S.

N.B.—The report of the Registrar-General of Births and Deaths, Federated Malay States, which was usually printed as an appendix to the Annual Medical Report in former years, is now printed as a separate report, *vide* ruling in F.S.G. 1153/31 and P.M.O. 1904/30, Pt. I.

TABLE I.

STAFF OF THE MEDICAL DEPARTMENT ON
31ST DECEMBER, 1931.

Principal Medical Officer

Personal Assistant to Principal Medical Officer

MEDICAL BRANCH.

4	Senior Medical Officers
1	Senior Surgeon
2	Surgeons
1	Ophthalmologist
1	Anæsthetist
31	Medical Officers
6	Lady Medical Officers
2	Pharmaceutical Chemists
4	Senior Deputy Medical Officers
11	Deputy Medical Officers
48	Assistant Medical Officers
14	Hospital Assistants, Special Grade (including 1 employed in the Health Branch)
1	Staff Assistant, Bungsar (formerly European) Hospital, Kuala Lumpur
71	Hospital Assistants, Grade I
255	Dressers, Grade II (including 2 employed in the Health Branch)
159	Dressers, Grade III
30	Probationer Dressers (including one at Leper Settlements, Sungei Buloh)
4	Matrons, Grade I
9	Matrons, Grade II (including 1 at Infant Welfare Centre)
70	European Nursing Sisters (including 10 at Infant Welfare Centres)
167	Asiatic Nurses (including 22 at Infant Welfare Centres)
31	Asiatic Midwives (including 1 at an Infant Welfare Centre)

HEALTH BRANCH.

Chief Health Officer

3 Senior Health Officers

20 Health Officers

1 Entomologist (temporary appointment)

5 Lady Medical Officers

1 Dental Surgeon

HEALTH BRANCH—(*cont.*)

- 2 Chief Sanitary Inspectors
- 1 European Steward at Quarantine Camp, Port Swettenham
- 5 Assistant Health Officers
- 1 Hospital Assistant, Special Grade
- 3 Senior Health Inspectors, Grade I
- 4 Senior Health Inspectors, Grade II
- 13 Health Inspectors, Grade I
- 35 Health Inspectors, Grade II
- 4 Probationer Health Inspectors
- 1 Dental Mechanic

INSTITUTE FOR MEDICAL RESEARCH.

- Director
- Bacteriologist
- Pathologist
- 2 Malaria Research Officers
- Entomologist
- 1 Chief Chemist
- 3 Chemists (one seconded to Department of Trade and Customs)
- 1 Deputy Medical Officer (Assistant Bacteriologist)
- 2 Assistant Medical Officers
- 1 Laboratory Assistant, Special Grade
- 4 Laboratory Assistants, Grade I
- 6 Laboratory Assistants, Grade II
- 10 Laboratory Assistants, Grade III
- 4 Probationers
- 1 Shorthand Typist
- 1 Storekeeper

CENTRAL MENTAL HOSPITAL.

- Medical Superintendent
- 1 Assistant Medical Superintendent
- 2 European Male Nurses
- 1 European Sister
- 1 Senior Assistant Physician (Senior Deputy Medical Officer)
- 3 Assistant Physicians (Assistant Medical Officers)
- 1 Inspector
- 1 Assistant Inspector
- 3 Dressers, Grade II
- 1 Dresser, Grade III
- 1 Probationer
- 3 Nurses
- 1 Workmistress
- 1 Steward

RADIOLOGICAL BRANCH.

Radiologist

- 1 European Lady Assistant in Electro-Therapy
- 2 X-Ray Assistants, Grade II
- 2 X-Ray Assistants, Grade III

SOCIAL HYGIENE BRANCH.

Chief Medical Officer

- 4 Assistant Medical Officers
- 5 Dressers, Grade II
- 1 Dresser, Grade III
- 5 Nurses

SUNGEI BULOH SETTLEMENTS.

Medical Superintendent

- 1 Assistant Medical Officer
- 2 Hospital Assistants, Grade I
- 2 Dressers, Grade II
- 2 Dressers, Grade III

STAFF CHANGES DURING THE YEAR 1931.

I.—SENIOR OFFICERS.

Dr. W. Young acted as Chief Medical Officer, Social Hygiene, Federated Malay States, until 22nd January; he assisted in the Principal Medical Officer's Office from 24th January to 23rd April.

Dr. C. E. Cobb acted as Senior Medical Officer, Pahang, until 4th September.

Dr. H. R. Dive acted as Senior Medical Officer, Perak, from 7th February to 3rd September as Senior Medical Officer, Selangor, from 16th September until the end of the year.

Dr. J. P. Fitzpatrick acted as Senior Medical Officer, Negri Sembilan, from 7th March to 26th November.

Dr. E. S. Lawrie, Medical Officer, acted as Surgeon, Negri Sembilan, until 1st April.

Dr. F. V. Jacques, Health Officer, acted as Senior Health Officer, Perak, from 4th April until the end of the year.

Dr. V. D. Wyborn, Medical Officer, was seconded to Avadi, India, on 25th April.

Dr. H. P. Hodge assisted in the Principal Medical Officer's Office until 30th May, and acted as Senior Medical Officer, Pahang, from 5th September until the end of the year.

Dr. D. M. McSwan, Medical Officer, was seconded to the Straits Settlements as Medical Officer, Tan Tock Seng Hospital, Singapore, from 6th June.

Dr. J. W. Field, Medical Officer, was appointed Malaria Research Officer II, Institute for Medical Research, Federated Malay States, on 30th May.

Mr. J. Shelton, Chemist, acted as Chief Chemist, Institute for Medical Research, Federated Malay States, from 11th March to 14th November.

Dr. J. W. Murdoch, Assistant Medical Superintendent, was promoted Medical Superintendent, Central Mental Hospital, Tanjong Rambutan, with effect from 2nd July.

Dr. G. I. H. Braine, Medical Officer, acted as Anæsthetist from 17th August until the end of the year.

Dr. A. K. Cosgrave, Senior Health Officer, Selangor and Pahang, acted as Chief Health Officer, Federated Malay States, in addition to his own duties from 19th September to 26th November. He acted as Chief Health Officer, Federated Malay States, from 27th November to 10th December.

Dr. A. G. H. Smart, Senior Health Officer, Selangor and Pahang, acted as Chief Health Officer, Federated Malay States, in addition to his own duties from 11th December until the end of the year.

Dr. P. H. Martin, Pathologist I, was appointed Bacteriologist, Institute for Medical Research, Federated Malay States, on 3rd December.

Dr. R. Lewthwaite, Pathologist II, was promoted Pathologist I, Institute for Medical Research, Federated Malay States, on 3rd December.

Dr. S. W. Eveson, Health Officer, Straits Settlements, was lent for service in the Federated Malay States for period from 28th January to 30th November.

Dr. M. J. Graham, Health Officer, was seconded to Kedah from 1st February to 26th November to act as Senior Health Officer.

Dr. L. Anigstein, Research Student in Tropical Medicine, Institute for Medical Research, Federated Malay States, left the service on the 15th January.

The following new appointments were made :

Mr. E. P. Hodgkin as Entomologist, Institute for Medical Research, Federated Malay States, on 20th February.

Dr. T. Wilson as Health Officer on 1st April.

Dr. B. A. Moss as Health Officer on 2nd April.

Dr. W. C. E. Diamond as Medical Officer on 2nd April.

Dr. L. D. Pringle as Medical Officer on 17th April.

Dr. G. F. West as Health Officer on 17th April.

Dr. E. C. Vardy as Medical Officer on 10th July.

RETIREMENTS, RESIGNATIONS, ETC.

Dr. W. O. Pou, Health Officer, retired with effect from 5th May.

Dr. (Mrs.) I. M. Dunlop, Lady Medical Officer, retired with effect from 14th March.

Dr. G. A. Dunlop, Medical Officer, resigned with effect from 1st April.

Dr. (Mrs.) M. McMahon, Temporary Lady Medical Officer, ceased work at the end of July.

Dr. (Mrs.) L. M. Bush, Temporary Lady Medical Officer, resigned from 31st January.

Dr. H. N. Walker, Medical Officer, left on termination of engagement on 5th April.

Dr. C. R. Amies, Malayan Research Officer II, Institute for Medical Research, Federated Malay States, left upon the termination of engagement on 29th May.

Dr. E. P. G. Ritchie, Health Officer, invalided from the service from 24th June.

Dr. C. F. Ashby, Medical Officer, proceeded on 26th June on leave prior to retirement.

Dr. (Mrs.) M. A. Gladwell, Lady Medical Officer, resigned with effect from 16th July.

Dr. (Mrs.) E. M. Rix, Lady Medical Inspector of Schools, left the service on 15th July, on abolition of appointment.

Dr. D. Bridges, State Surgeon, Kedah, proceeded on 26th July on leave prior to retirement.

Dr. N. V. McKenna, Medical Officer, left the service on termination of appointment on 8th August.

Dr. E. G. Morris, Medical Officer, left the service on expiration of engagement on 4th September.

Dr. C. E. Cobb, Medical Officer, proceeded on 5th September, on leave prior to retirement.

II.—STAFF OF EUROPEAN NURSING SISTERS.

NEW APPOINTMENT.

Miss D. Menzies appointed on 7th August.

RETIREMENTS, RESIGNATIONS, ETC.

Miss P. M. Colledge resigned on 2nd February.

Miss M. M. Poulson resigned on 28th February.

Mrs. W. H. Barrett nee (E. Howard) engagement terminated on 24th May.

Mrs. M. Colbert retired upon termination of engagement on 8th August.

Miss E. Fisher, Matron I, resigned on 27th October.

Miss E. J. McCarthy, Matron I, proceeded on 11th November on leave prior to retirement.

CENTRAL MENTAL HOSPITAL.

Mr. A. P. Chandler, European Male Nurse, engagement terminated on 25th July, on abolition of appointment.

Mrs. F. L. Chandler, European Sister, engagement terminated on 25th July, on abolition of appointment.

Miss M. J. Lamb, European Sister, engagement terminated on 8th August, on abolition of appointment.

Miss A. O'Sullivan, European Sister, engagement terminated on 21st August, on abolition of appointment.

III.—LOCALLY APPOINTED OFFICERS.

APPOINTMENTS.

The following new appointments of Assistant Medical Officers were made:

Mr. T. Arumugam (re-engaged) on 2nd February.

Mr. R. Mukerji on 8th May.

Mr. C. V. Jumeaux on 1st June.

RETIREMENTS, RESIGNATIONS, ETC.

Mr. J. E. Lesslar, Assistant Pathologist, Institute for Medical Research, Federated Malay States, retired on 12th May.

Mr. C. R. Paul, temporary engagement, terminated on 31st May.

Mr. Charan Singh, temporary engagement, terminated on 30th June.

Mr. Kirpal Singh Sodhi, temporary engagement, terminated on 30th June.

Mr. S. Danasamy, Deputy Medical Officer, died on 14th December.

Mr. R. Mukerji resigned on the 31st December.

The appointments of the following officers were abolished and they retired from the end of the year:

Mr. G. Abraham, Senior Deputy Medical Officer.

Mr. M. Gupta, Senior Deputy Medical Officer.

Mr. E. J. De Cruze, Deputy Medical Officer.

Mr. K. N. Ghosh, Deputy Medical Officer.

TABLE II.
STATEMENT OF REVENUE AND EXPENDITURE UNDER
“PERSONAL EMOLUMENTS” AND “OTHER CHARGES”, 1931.

Expenditure Detailed.	Personal Emoluments.	Other Charges.	
		Annually Recurrent.	Special Expenditure.
	\$ c.	\$ c.	\$ c.
1. Principal Medical Officer, Federated Malay States...	49,173 30	43,467 03	2,085 28
2. Radiologist, F.M.S. ...	15,860 00	15,218 74	1,385 00
3. Director, Institute for Medical Research, F.M.S.	148,507 89	49,062 51	1,313 12
4. Chief Medical Officer, Social Hygiene, F.M.S. ...	28,980 29	10,498 98	863 07
5. Dental Clinic ...	7,989 10	4,718 50	225 00
6. College of Medicine, Singapore... ..	97,384 12	74,751 19	6,641 74
7. Medical Superintendent, Central Mental Hospital, Tanjong Rambutan ...	92,055 86	358,231 99	392 50
8. Senior Medical Officer, } Perak	1,882,051 23	670,389 37	15,992 08
9. Senior Medical Officer, } Selangor		503,112 00	7,836 00
10. Senior Medical Officer, } Negri Sembilan ...		280,315 00	4,616 00
11. Senior Medical Officer, } Pahang... ..		198,927 26	8,872 83
12. Chief Health Officer, F.M.S.	454,660 31	124,774 23	4,321 05
13. Infant Welfare Centres ...	84,194 22	57,822 39	2,406 67
14. Medical Superintendent, Sungei Buloh Settlements, Sungei Buloh	24,965 60	267,138 67	546 45
15. Temporary Allowances (Medical)	210,545 48		
16. Temporary Allowances (Clerical)	21,714 32		
Total ...	3,118,081 72	2,658,427 86	57,496 79

	Revenue for 1931, hospital fees, licences, etc.
1. Principal Medical Officer, Federated Malay States ...	\$ 9,470 00
2. Radiologist, Federated Malay States	9,163 50
3. Director, Institute for Medical Research, Federated Malay States	24,818 10
4. College of Medicine, Singapore	18,268 15
5. Superintendent, Central Mental Hospital, Tanjong Rambutan	80,044 61
6. Senior Medical Officer, Perak	97,847 13
7. Senior Medical Officer, Selangor	104,702 00
8. Senior Medical Officer, Negri Sembilan	41,534 69
9. Senior Medical Officer, Pahang	16,137 66
10. Chief Health Officer, Federated Malay States	4,085 20

TABLE III.

THE ANNUAL RETURN OF DISEASES AND DEATHS (IN-PATIENTS) IN GOVERNMENT HOSPITALS FOR THE YEAR 1931 (EXCLUDING THE CENTRAL MENTAL HOSPITAL, THE LEPER AND DECREPIT SETTLEMENTS AND THE PORT SWETTENHAM QUARANTINE HOSPITAL).

Diseases.	*Remaining in hospital at end of 1930.	Yearly Total.		† Total cases treated.	‡ Remaining in hospital at end of 1931.
		Admissions.	Deaths.		
I.—EPIDEMIC, ENDEMIC, AND INFECTIOUS DISEASES.					
1. Enteric group—					
(a) Typhoid fever	29	279	87	308	20
(b) Paratyphoid A. ... ..	...	22	1	22	1
(c) Paratyphoid B. ... ..	...	4	...	4	...
(d) Paratyphoid C.	1	2	...	3	...
(e) Type not defined	1	8	3	9	...
2. Typhus (Tropical)	12	207	24	219	18
3. Relapsing fever ... ..	...	1	...	1	...
4. Undulant fever (Malta fever) ... ..	...	...	...	...	...
5. Malaria—					
(a) Tertian	133	5,010	63	5,143	88
(b) Quartan	21	745	6	766	26
(c) Aestivo-autumnal	301	9,529	609	9,830	218
(d) Mixed infection	21	699	52	720	15
(e) Undefined microscopically	130	3,749	186	3,879	80
(f) Cachexia	112	3,169	149	3,281	88
(g) Black-water fever	2	25	7	27	...
6. A.—Smallpox ... ..	...	3	...	3	...
B.—Alastrim ... ..	...	...	...	...	...
7. Measles	1	82	...	83	4
8. Scarlet fever ... ..	...	...	...	...	...
9. Whooping cough	1	46	2	47	...
10. Diphtheria	1	120	28	121	14
11. Influenza	68	5,775	25	5,843	32
12. Miliary fever ... ..	...	...	...	...	...
13. Mumps	4	71	...	75	...
14. Cholera ... ..	...	...	...	...	...
15. Epidemic diarrhoea ... ..	...	...	...	...	...
16. Dysentery—					
(a) Amœbic	40	829	110	869	44
(b) Bacillary	77	789	234	866	38
(c) Undefined or due to other causes	19	305	47	324	7
17. Plague—					
(a) Bubonic ... ..	...	...	...	...	...
(b) Pneumonic ... ..	...	...	...	...	...
(c) Septicæmic ... ..	...	...	...	...	...
(d) Undefined ... ..	...	...	...	...	...
18. Yellow fever ... ..	...	...	...	...	...
19. Leptospirosis... ..	...	27	12	27	...
20. Leprosy	8	265	3	273	6
21. Erysipelas	3	80	7	83	4
22. Acute poliomyelitis ... ..	...	3	1	3	...
23. Encephalitis lethargica	3	15	4	18	4
24. Epidemic cerebro-spinal fever ... ..	...	7	7	7	...
25. Other epidemic diseases—					
(a) Rubella (German measles)	3	2	...	5	...
(b) Varicella (chicken-pox)	10	149	...	159	10

The form shows in the main the arrangement of diseases in the International Nomenclature, 1921 Edition. To save space the unimportant diseases of any class can be grouped in their places as "Other Diseases" of the class.

* i.e., the year previous to that for which the return is made. † "Total cases treated" will, of course, include those remaining in hospital at the end of the previous year. ‡ The figures in this column to be carried on to the next year's return.

TABLE III—(cont.)
 RETURN OF DISEASES AND DEATHS (IN-PATIENTS)
 FOR THE YEAR 1931—(cont.)

Diseases,	* Remaining in hospital at end of 1930.	Yearly Total.		† Total cases treated.	‡ Remaining in hospital at end of 1931.
		Admissions.	Deaths.		
I.—EPIDEMIC, ENDEMIC, AND INFECTIOUS DISEASES—(cont.)					
Other epidemic diseases—(cont.)					
(c) Kala-azar ... ..	...	...	...	...	...
(d) Phlebotomus fever ... ..	...	...	...	...	...
(e) Dengue... ..	1	64	...	65	2
(f) Epidemic dropsy ... ..	...	...	...	...	...
(g) Yaws	13	182	...	195	12
(h) Trypanosomiasis ... ..	...	...	...	...	...
26. Glanders ... ..	...	...	...	...	...
27. Anthrax ... ..	...	...	...	...	...
28. Rabies... ..	...	2	...	2	...
29. Tetanus	2	119	90	121	3
30. Mycosis ... ..	...	4	...	4	1
31. Tuberculosis, pulmonary and laryngeal	235	2,179	975	2,414	259
32. Tuberculosis of the meninges or central nervous system ... ..	...	20	17	20	1
33. Tuberculosis of the intestines or peritoneum	2	31	20	33	1
34. Tuberculosis of the vertebral column	6	24	6	30	5
35. Tuberculosis of bones and joints	18	51	3	69	17
36. Tuberculosis of other organs—					
(a) Skin or subcutaneous tissue (lupus) ... ..	...	3	...	3	...
(b) Lymphatic system	9	56	3	65	7
(c) Genito-urinary ... ..	...	7	2	7	1
(d) Other organs	1	6	4	7	...
37. Tuberculosis disseminated—					
(a) Acute ... ..	...	14	14	14	...
(b) Chronic ... ..	...	...	...	...	...
38. Syphilis—					
(a) Primary	60	817	...	877	44
(b) Secondary	85	994	1	1,079	84
(c) Tertiary	77	419	29	496	55
(d) Hereditary	2	70	38	72	4
(e) Period not indicated	9	50	5	59	4
39. Soft chancre	28	331	...	359	16
40. A.—Gonorrhœa and its complications	73	1,591	1	1,664	87
B.—Gonorrhœal ophthalmia	12	85	1	97	7
C.—Gonorrhœal arthritis	18	264	1	282	30
D.—Granuloma venereum	1	19	...	20	5
41. Septicæmia ... ..	...	100	89	100	...
42. Other infectious diseases—					
Filariasis
Tsutsugamushi fever (Japanese river fever)	8	4	8	...

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* i.e., the year previous to that for which the return is made. † "Total cases treated" will, of course, include those remaining in hospital at the end of the previous year. ‡ The figures in this column to be carried on to the next year's return.

TABLE III—(cont.)

RETURN OF DISEASES AND DEATHS (IN-PATIENTS)
FOR THE YEAR 1931—(cont.)

Diseases.	* Remaining in hospital at end of 1930.	Yearly Total.		† Total cases treated.	‡ Remaining in hospital at end of 1931.
		Admissions.	Deaths.		
II.—GENERAL DISEASES NOT MENTIONED ABOVE.					
43. Cancer or other malignant tumours of the buccal cavity	4	39	13	43	8
44. Cancer or other malignant tumours of the stomach or liver	5	93	67	98	7
45. Cancer or other malignant tumours of the peritoneum intestines, rectum ... ..	...	22	8	22	3
46. Cancer or other malignant tumours of the female genital organs	1	42	8	43	4
47. Cancer or other malignant tumours of the breast	1	9	5	10	...
48. Cancer or other malignant tumours of the skin	4	34	14	38	1
49. Cancer or other malignant tumours of organs not specified	11	109	44	120	7
50. Tumours non-malignant	12	178	1	190	7
51. Acute rheumatism	5	61	...	66	...
52. Chronic rheumatism	7	172	...	179	10
53. Scurvy (including Barlow's disease) ... ..	...	6	2	6	...
54. Pellagra ... ..	...	1	1	1	...
55. Beri-beri	303	1,036	105	1,339	112
56. Rickets	1	4	...	5	4
56A. Other deficiency diseases ... ..	...	1	...	1	...
57. Diabetes mellitus	8	124	8	132	7
58. Anæmia—					
(a) Pernicious	4	20	11	24	2
(b) Other anæmias and chlorosis	66	1,124	278	1,190	64
59. Diseases of the pituitary body ... ..	...	2	...	2	...
60. Diseases of the thyroid gland—					
(a) Exophthalmic goitre	1	8	...	9	...
(b) Other diseases of the thyroid gland, myxœdema, etc. ... ..	...	17	...	17	...
61. Diseases of the para-thyroid glands ... ..	...	2	...	2	...
62. Diseases of the thymus ... ..	...	...	...	...	...
63. Diseases of the supra-renal glands ... ..	...	1	...	1	...
64. Diseases of the spleen	4	46	4	50	1
65. Leukæmia—					
(a) Myelogenous ... ..	...	2	1	2	...
(b) Lymphatic	1	2	3	3	...
(c) Undefined ... ..	...	2	...	2	...
65A. Hodgkin's disease (lymphadenoma)	1	11	4	12	...
66. Alcoholism ... ..	...	38	1	38	...
67. Chronic poisoning by mineral substances (lead, mercury, etc.)	4	34	4	38	3
68. Chronic poisoning by organic substances (morphia, cocaine, etc.)	6	71	4	77	1
69. Other general diseases—					
(a) Auto-intoxication ... ..	...	6	3	6	...
(b) Purpura hæmorrhagica	3	1	3	...
(c) Hæmophilia	2	2	2	...
(d) Diabetes insipidus	16	...	16	1
(e) Other	10	93	13	103	9

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* i.e., the year previous to that for which the return is made. † "Total cases treated" will, of course, include those remaining in hospital at the end of the previous year. ‡ The figures in this column to be carried on to the next year's return.

TABLE III—(cont.)
RETURN OF DISEASES AND DEATHS (IN-PATIENTS)
FOR THE YEAR 1931—(cont.)

Diseases.	* Remaining in hospital at end of 1930.	Yearly Total.		† Total cases treated.	‡ Remaining in hospital at end of 1931.
		Admissions.	Deaths.		
III.—AFFECTIONS OF THE NERVOUS SYSTEM AND ORGANS OF THE SENSES.					
70. Encephalitis (not including encephalitis lethargica)	1	17	10	18	...
71. Meningitis (not including tuberculous meningitis or cerebro-spinal meningitis) ... ..	...	47	39	47	1
72. Locomotor ataxia	6	31	...	37	13
73. Other affections of the spinal cord	6	49	3	55	11
74. Apoplexy—					
(a) Hæmorrhage ... ..	...	45	38	45	...
(b) Embolism ... ..	...	3	3	3	...
(c) Thrombosis ... ..	...	5	3	5	...
75. Paralysis—					
(a) Hemiplegia	45	126	29	171	41
(b) Other paralyzes	27	94	15	127	30
76. General paralysis of the insane ...	...	4	1	4	...
77. Other forms of mental alienation ...	12	646	1	658	10
78. Epilepsy	3	112	7	115	9
79. Convulsions (non-puerperal) 5 years or over ... ..	...	19	7	19	1
80. Infantile convulsions (<i>see</i> XII Diseases of Infancy) ... ..	...	21	12	21	...
81. Chorea ... ..	...	1	...	1	1
82. A.—Hysteria ... ..	...	8	...	8	...
B.—Neuritis	12	195	1	207	7
C.—Neurasthenia	3	50	...	53	...
D.—Neuralgia	2	152	...	154	3
83. Cerebral softening	1	5	3	6	1
84. Other affections of the nervous system	5	58	3	63	5
85. Affections of the organs of vision—					
(a) Conjunctivitis... ..	13	566	...	579	10
(b) Trachoma	16	109	...	125	16
(c) Tumours of the eye ... ..	...	9	...	9	...
(d) Other affections of the eye ...	154	1,005	3	1,159	144
86. Affections of the ear or mastoid sinus	10	316	...	326	14
IV.—AFFECTIONS OF THE CIRCULATORY SYSTEM.					
87. Pericarditis ... ..	...	17	11	17	1
88. Acute endocarditis or myocarditis	1	24	20	25	3
89. Angina pectoris ... ..	...	3	...	3	...
90. Other diseases of the heart—					
(a) Valvular—					
Mitral	12	158	50	170	17
Aortic	5	75	34	80	2
Tricuspid ... ..	...	4	1	4	1
Pulmonary ... ..	...	...	...	...	...
Undefined	2	35	14	37	1
(b) Myocarditis	17	237	127	254	16
(c) Functional	8	3	8	...
(d) Other	5	53	31	58	2

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* i.e., the year previous to that for which the return is made. † "Total cases treated" will, of course, include those remaining in hospital at the end of the previous year, ‡ The figures in this column to be carried on to the next year's return,

TABLE III—(cont.)

RETURN OF DISEASES AND DEATHS (IN-PATIENTS)
FOR THE YEAR 1931—(cont.)

Diseases.	* Remaining in hospital at end of 1930.	Yearly Total.		† Total cases treated.	‡ Remaining in hospital at end of 1931.
		Admissions.	Deaths.		
IV.—AFFECTIONS OF THE CIRCULATORY SYSTEM—(cont.)					
91. Diseases of the arteries—					
(a) Aneurism	1	18	5	19	2
(b) Arterio-sclerosis	2	49	22	51	2
(c) Other diseases... ..	1	27	2	28	2
92. Embolism or thrombosis (non-cerebral) ... ..	...	10	5	10	...
93. Diseases of the veins—					
(a) Hæmorrhoids	6	228	...	234	4
(b) Varicose veins... ..	1	10	...	11	...
(c) Phlebitis	1	20	1	21	2
94. Diseases of the lymphatic system—					
Lymphangitis	1	48	...	49	...
Lymphadenitis, bubo (non-specific)	25	385	1	410	33
95. Hæmorrhage of undetermined cause .. ..	...	9	1	9	...
96. Other affections of the circulatory system ... ..	...	11	...	11	...
V.—AFFECTIONS OF THE RESPIRATORY SYSTEM.					
97. Diseases of the nasal passages—					
(a) Adenoids	1	12	...	13	1
(b) Polypus ... ..	...	19	...	19	...
(c) Rhinitis ... ..	...	15	...	15	1
(d) Coryza	5	194	...	199	2
(e) Other ... ..	...	59	...	59	2
98. Affections of the larynx—					
Laryngitis ... ..	...	41	4	41	1
99. Bronchitis—					
(a) Acute	83	1,852	25	1,935	48
(b) Chronic	48	935	44	983	39
100. Broncho-pneumonia	34	775	346	809	24
101. Pneumonia—					
(a) Lobar	68	1,535	689	1,603	37
(b) Unclassified	4	82	33	86	1
102. Pleurisy—					
(a) Dry pleurisy	5	188	3	193	8
(b) Pleural effusion	11	102	13	113	8
(c) Empyema	4	32	12	36	1
103. Congestion of the lungs ... ..	...	39	6	39	1
104. Gangrene of the lungs ... ..	...	17	16	17	...
105. Asthma	42	683	10	725	33
106. Pulmonary emphysema ... ..	...	9	3	9	...
107. Other affections of the lungs—					
(a) Pulmonary spirochaetosis	2	1	2	...
(b) Other	1	86	30	87	2

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TABLE III—(cont.)

RETURN OF DISEASES AND DEATHS (IN-PATIENTS)
FOR THE YEAR 1931—(cont.)

Diseases.	* Remaining in hospital at end of 1930.	Yearly Total.		† Total cases treated.	‡ Remaining in hospital at end of 1931.
		Admissions.	Deaths.		
VI.—DISEASES OF THE DIGESTIVE SYSTEM.					
108. A.—Diseases of teeth or gums— Caries, pyorrhœa, etc. ...	10	297	2	307	4
B.—Other affections of the mouth— (a) Stomatitis	3	85	1	88	3
(b) Cancrum oris ... ..	...	10	7	10	...
(c) Glossitis ... ..	...	15	1	15	...
(d) Other ... ..	...	10	...	10	1
109. Affections of the pharynx or tonsils— (a) Tonsillitis	5	250	1	255	5
(b) Pharyngitis	3	153	...	156	2
(c) Other	1	26	1	27	...
110. Affections of the œsophagus ...	1	10	3	11	2
111. A.—Ulcer of the stomach ...	8	173	27	181	13
B.— „ duodenum ...	4	60	9	64	8
112. Other affections of the stomach— (a) Gastritis	15	442	...	457	13
(b) Dyspepsia, etc.	7	365	1	372	4
(c) Other .. ...	...	2	...	2	...
113. Diarrhœa and enteritis (in children under two years of age) ...	4	300	97	304	9
114. A.—Diarrhœa and enteritis (in patients over two years of age) ...	58	1,412	160	1,470	26
B.—Colitis	3	61	2	64	3
C.—Sprue	2	103	10	105	8
115. Ankylostomiasis	38	837	13	875	36
116. Diseases due to intestinal parasites— (a) Cestoda (tænia) ... ..	...	2	...	2	...
(b) Trematoda (flukes) ... ..	...	2	1	2	...
(c) Nematoda (other than ankylostoma)— Ascaris	36	1,540	4	1,576	35
Trichocephalus dispar ... ..	...	3	...	3	...
Trichina ... ..	...	...	...	...	...
Dracunculus	2	4	...	6	...
Strongylus ... ..	...	...	...	...	...
Oxyuris	1	4	...	5	...
(d) Coccidia ... ..	...	...	...	...	...
(e) Other parasites ... ..	...	1	...	1	...
(f) Unclassified ... ..	...	9	...	9	...
117. Appendicitis	17	270	16	287	10
118. Hernia	19	271	12	290	12
119. A.—Affections of the anus, fistula, etc.	4	201	...	205	12
B.—Other affections of the intestines— (a) Enteroptosis	2	...	2	...
(b) Constipation	6	593	...	599	4
(c) Colic	3	95	...	98	2
(d) Other	3	266	22	269	1

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* i.e., the year previous to that for which the return is made. † "Total cases treated" will, of course, include those remaining in hospital at the end of the previous year. ‡ The figures in this column to be carried on to the next year's return.

TABLE III—(cont.)
RETURN OF DISEASES AND DEATHS (IN-PATIENTS)
FOR THE YEAR 1931—(cont.)

Diseases.	* Remaining in hospital at end of 1930.	Yearly Total.		† Total cases treated.	‡ Remaining in hospital at end of 1931.
		Admissions.	Deaths.		
VI.—DISEASES OF THE DIGESTIVE SYSTEM--(cont.)					
120. Acute yellow atrophy of the liver	...	...	...	...	...
121. Hydatid of the liver	...	1	...	1	...
122. Cirrhosis of the liver—					
(a) Alcoholic	1	13	5	14	...
(b) Other forms	32	309	148	341	36
123. Biliary calculus	...	15	3	15	...
124. Other affections of the liver—					
(a) Abscess	4	55	17	59	5
(b) Hepatitis	6	131	4	137	8
(c) Cholecystitis	1	74	12	75	2
(d) Jaundice	6	133	8	139	3
(e) Other	...	21	13	21	...
125. Diseases of the pancreas	...	5	4	5	...
126. Peritonitis (of unknown cause)	4	72	56	76	3
127. Other affections of the digestive system	2	78	14	80	1
VII.—DISEASES OF THE GENITO-URINARY SYSTEM (NON-VENEREAL).					
128. Acute nephritis	26	335	96	361	22
129. Chronic nephritis	27	435	134	462	42
130. A.—Chyluria	...	2	...	2	...
B.—Schistosomiasis	...	...	...	...	...
131. Other affections of the kidneys (pyelitis, etc.)	6	175	44	181	6
132. Urinary calculus	5	72	3	77	10
133. Diseases of the bladder (cystitis, etc.)	2	159	10	161	5
134. Diseases of the urethra—					
(a) Stricture	3	89	...	92	6
(b) Other	10	174	1	184	7
135. Diseases of the prostate—					
(a) Hypertrophy	...	2	...	2	...
(b) Prostatitis	2	17	...	19	...
136. Diseases (non-venereal) of the genital organs of man—					
(a) Epididymitis	...	60	...	60	...
(b) Orchitis	1	66	...	67	2
(c) Hydrocele	3	88	...	91	5
(d) Other	9	150	...	159	3
137. Cysts or other non-malignant tumours of the ovaries	2	28	1	30	2
138. A.—Salpingitis	5	52	1	57	1
B.—Abscess of the pelvis	1	14	2	15	1
139. Uterine tumours (non-malignant)	...	22	...	22	...
140. Uterine hæmorrhage (non-puerperal)	...	18	...	18	...
141. A.—Metritis	2	16	1	18	...

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* i.e., the year previous to that for which the return is made. † "Total cases treated" will, of course, include those remaining in hospital at the end of the previous year. ‡ The figures in this column to be carried on to the next year's return.

TABLE III—(cont.)
 RETURN OF DISEASES AND DEATHS (IN-PATIENTS)
 FOR THE YEAR 1931—(cont.)

Diseases.	* Remaining in hospital at end of 1930.	Yearly Total.		† Total cases treated.	‡ Remaining in hospital at end of 1931.
		Admissions.	Deaths.		
VII.—DISEASES OF THE GENITO-URINARY SYSTEM (NON-VENEREAL)—(cont.)					
B.—Other affections of the female genital organs—					
(a) Displacements of uterus ...	2	65	...	67	3
(b) Amenorrhœa	1	17	...	18	...
(c) Dysmenorrhœa ... ..	...	43	...	43	...
(d) Leucorrhœa	1	112	...	113	3
(e) Other	4	240	...	244	8
142. Diseases of the breast (non-puerperal)—					
(a) Mastitis ... ..	...	14	...	14	1
(b) Abscess of breast	1	27	...	28	1
VIII.—PUERPERAL STATE.					
143. A.—Admitted for ante-natal observation	73	878	1	951	132
B.—Normal labour... ..	114	4,198	4	4,312	127
C.—Difficult labour	8	253	13	261	12
D.—Accidents of pregnancy—					
(a) Abortion	5	317	4	322	8
(b) Ectopic gestation ... ..	...	19	5	19	1
(c) Anæmia of pregnancy ... ..	...	39	26	39	1
(d) Other accidents of pregnancy	8	235	21	243	8
144. Puerperal hæmorrhage ... ..	...	16	10	16	1
145. Other accidents of parturition ...	1	152	30	153	5
146. Puerperal septicæmia	6	157	72	163	1
147. Phlegmasia dolens ... ..	...	7	...	7	1
148. Puerperal eclampsia ... ..	...	72	25	72	4
149. Sequelæ of labour	1	17	1	18	...
150. Puerperal affections of the breast	...	2	...	2	...
IX.—AFFECTIONS OF THE SKIN AND CELLULAR TISSUES.					
151. Gangrene	3	45	11	48	4
152. A.—Boil	8	127	...	135	3
B.—Carbuncle	7	82	...	89	7
153. A.—Abscess	104	1,857	17	1,961	70
B.—Whitlow	2	41	...	43	1
C.—Cellulitis	69	625	51	694	47
154. A.—Tinea	4	144	...	148	6
B.—Scabies	20	449	...	469	10
155. Other diseases of the skin—					
(a) Erythema	1	7	..	8	...
(b) Urticaria	3	54	...	57	1
(c) Eczema	14	506	...	520	18
(d) Herpes	3	94	...	97	1
(e) Psoriasis	13	...	13	...
(f) Elephantiasis...	18	...	18	...
(g) Myiasis
(h) Chigoes

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* i.e., the year previous to that for which the return is made. † "Total cases treated" will, of course, include those remaining in hospital at the end of the previous year. ‡ The figures in this column to be carried on to the next year's return.

TABLE III—(cont.)

RETURN OF DISEASES AND DEATHS (IN-PATIENTS)
FOR THE YEAR 1931—(cont.)

Diseases.	* Remaining in hospital at end of 1930.	Yearly Total.		† Total cases treated.	‡ Remaining in hospital at end of 1931.
		Admissions.	Deaths.		
IX.—AFFECTIONS OF THE SKIN AND CELLULAR TISSUES—(cont.)					
Other diseases of the skin—(cont.)					
(i) Cutaneous leishmaniasis ...	...	...	...	...	...
(j) Other	23	386	4	409	26
155A. Chronic ulcer	454	4,438	67	4,892	254
X.—DISEASES OF BONES AND ORGANS OF LOCOMOTION (OTHER THAN TUBERCULOUS).					
156. Diseases of bones (Osteitis, etc.)...	9	79	1	88	5
157. Diseases of joints—					
(a) Arthritis	24	339	1	363	28
(b) Synovitis	10	130	...	140	3
158. Other diseases of bones or organs of locomotion	32	384	3	416	20
XI.—MALFORMATIONS.					
159. Malformations—					
(a) Hydrocephalus ... ..	...	5	3	5	...
(b) Hypospadias ... ..	...	...	...	...	...
(c) Spina bifida ... ..	...	5	...	5	...
(d) Other	3	48	9	51	3
XII.—DISEASES OF INFANCY.					
160. Congenital debility	1	85	49	86	3
161. Premature birth	1	321	266	322	2
162. A.—Infantile convulsions...	...	47	27	47	2
B.—Other affections of infancy ...	6	165	90	171	8
163. Infant neglect (infants of three months or over) ... ..	...	15	12	15	1
XIII.—AFFECTIONS OF OLD AGE.					
164. Senility—					
(a) Senile dementia ... ..	...	3	...	3	...
(b) Senile debility	157	525	113	682	136
XIV.—AFFECTIONS PRODUCED BY EXTERNAL CAUSES.					
165. Suicide by poisoning ... ..	...	4	4	4	...
166. Corrosive poisoning (intentional) ...	...	9	3	9	...
167. Suicide by gas poisoning ... ..	...	...	...	...	...
168. Suicide by hanging or strangulation ...	...	2	2	2	...
169. Suicide by drowning ... ..	...	...	...	...	...
170. Suicide by firearms ... ..	...	...	...	...	...
171. Suicide by cutting or stabbing instruments	1	4	2	5	...
172. Suicide by jumping from a height ...	...	...	...	...	...
173. Suicide by crushing ... ..	...	...	...	...	...

The form shows in the main the arrangement of diseases in the International Nomenclature, 1921 Edition. To save space the unimportant diseases of any class can be grouped in their places as "Other Diseases" of the class.

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TABLE III—(cont.)
RETURN OF DISEASES AND DEATHS (IN-PATIENTS)
FOR THE YEAR 1931—(cont.)

Diseases.	*Remaining in hospital at end of 1930.	Yearly Total.		†Total cases treated.	†Remaining in hospital at end of 1931.
		Admissions.	Deaths.		
XIV.—AFFECTIONS PRODUCED BY EXTERNAL CAUSES—(cont.)					
174. Other suicides ... ..	...	...	...	...	...
175. A.—Food poisoning ... ..	...	30	2	30	...
B.—Botulism ... ..	...	2	...	2	...
176. Attacks of poisonous animals—					
(a) Snake bite	1	33	...	34	1
(b) Insect bite	1	45	...	46	1
177. Other poisonings	4	85	8	89	1
A.—Datura poisoning	1	51	...	52	...
178. Burns (by fire)	10	159	15	169	13
179. Burns (other than by fire)	12	222	11	234	12
180. Suffocation (accidental) ... ..	...	...	...	...	...
181. Poisoning by gas (accidental) ... ..	...	10	...	10	...
182. Drowning (accidental) ... ..	...	...	...	...	...
183. Wounds by firearms (war ex- cepted)	1	36	2	37	...
184. Wounds by cutting or stabbing instruments	87	1,950	41	2,037	63
185. Wounds by fall	58	1,649	9	1,707	55
186. Wounds in mines or quarries	3	174	5	177	5
187. Wounds by machinery	1	288	5	289	12
188. Wounds by crushing (e.g., railway accidents, etc.)	10	88	8	98	3
189. Injuries inflicted by animals, bites, kicks, etc.	2	153	3	155	...
190. Wounds inflicted on active service ... ..	...	1	...	1	...
191. Executions of civilians by bel- ligerents ... ..	...	...	...	...	...
192. A.—Over fatigue ... ..	...	2	...	2	...
B.—Hunger or thirst ... ..	...	1	1	1	...
193. Exposure to cold, frost bite, etc....	...	...	...	...	...
194. Exposure to Heat—					
(a) Heatstroke ... ..	...	...	...	...	...
(b) Sunstroke ... ..	...	2	...	2	...
195. Lightning stroke ... ..	...	2	...	2	...
196. Electric shock	1	3	...	4	...
197. Murder by firearms ... ..	...	...	...	...	...
198. Murder by cutting or stabbing instruments ... ..	...	...	...	...	...
199. Murder by other means ... ..	...	1	1	1	...
200. Infanticide (murder of an infant under one year) ... ..	...	...	...	...	...
201. A.—Dislocation	3	74	...	77	7
B.—Sprain	2	256	...	258	7
C.—Fracture	121	1,005	80	1,126	116
202. Other external injuries	57	1,668	7	1,725	47
202A. Concussion ... ..	...	13	1	13	1
203. Deaths by violence of unknown cause ... ..	...	1	1	1	...

The form shows in the main the arrangement of diseases in the International Nomenclature, 1921 Edition. To save space the unimportant diseases of any class can be grouped in their places as "Other Diseases" of the class.
* i.e., the year previous to that for which the return is made. † "Total cases treated" will, of course, include those remaining in hospital at the end of the previous year.
‡ The figures in this column to be carried on to the next year's return.

TABLE III—(cont.)

RETURN OF DISEASES AND DEATHS (IN-PATIENTS)
FOR THE YEAR 1931—(cont.)

Diseases.	* Remaining in hospital at end of 1930.	Yearly Total.		† Total cases treated.	‡ Remaining in hospital at end of 1931.
		Admissions.	Deaths.		
XV.—ILL-DEFINED DISEASES.					
204. Sudden death (cause unknown) ...	...	1	1	1	...
205. A.—Diseases not already specified or ill-defined—					
(a) Ascites	4	24	4	28	1
(b) Œdema	10	32	4	42	...
(c) Asthenia	1	135	20	136	6
(d) Shock ... ..	...	26	...	26	...
(e) Hyperpyrexia ... ..	...	10	3	10	...
B.—Malingering ... ..	...	27	...	27	...
C.—Pyrexia of uncertain origin ...	7	358	24	365	4
D.—Diagnosis undetermined ...	89	741	...	830	88
Total ...	4,897	92,806	7,452	97,703	4,029
NATIONALITIES.					
Europeans	39	1,170	23	1,209	39
Eurasians	7	450	16	457	13
Chinese	2,621	32,748	3,885	35,369	1,999
Indians	1,926	49,870	3,297	51,796	1,658
Malays	248	7,391	161	7,639	263
Javanese	32	491	43	523	37
Japanese	1	67	6	68	3
Others	23	619	21	642	17
Total ...	4,897	92,806	7,452	97,703	4,029

The form shows in the main the arrangement of diseases in the International Nomenclature, 1921 Edition. To save space the unimportant diseases of any class can be grouped in their places as "Other Diseases" of the class.

* i.e., the year previous to that for which the return is made. † "Total cases treated" will, of course, include those remaining in hospital at the end of the previous year. ‡ The figures in this column to be carried on to the next year's return.

TABLE IV.

The Annual Return of Diseases (out-patients) treated at all Government hospitals, stationary dispensaries, and travelling dispensaries (excluding Infant Welfare Centres, and Social Hygiene and other special clinics).

Diseases.	Male.	Female.	Total.
I.—Epidemic, endemic and infectious diseases	114,957 ...	30,676 ...	145,633
II.—General diseases not mentioned above	17,307 ...	6,081 ...	23,388
III.—Affections of the nervous system and organs of the senses	27,500 ...	9,177 ...	36,677
IV.—Affections of the circulatory system ...	1,301 ...	330 ...	1,631
V.—Affections of the respiratory system ...	40,663 ...	12,835 ...	53,498
VI.—Diseases of the digestive system ...	118,670 ...	47,336 ...	166,006
VII.—Diseases of the genito-urinary system (non-venereal)	2,005 ...	2,807 ...	4,812
VIII.—Puerperal state	— ...	2,291 ...	2,291
IX.—Affections of the skin and cellular tissues	117,253 ...	24,351 ...	141,604
X.—Diseases of bones and organs of locomotion (other than tuberculosis)	4,606 ...	1,967 ...	6,573
XI.—Malformations	2 ...	3 ...	5
XII.—Diseases of infancy	138 ...	73 ...	211
XIII.—Affections of old age	1,557 ...	333 ...	1,890
XIV.—Affections produced by external causes	43,537 ...	7,447 ...	50,984
XV.—Ill-defined diseases	4,883 ...	1,281 ...	6,164
Total ...	494,769 ...	146,988 ...	641,757

TABLE V.

Summary of the major operations at the District Hospital, Ipoh, the General and District Hospitals, Kuala Lumpur, and the General Hospital, Seremban, and European Hospitals, 1931.

	Asiatics.	Europeans.
I.—Head and Neck—		
Mastoid operation	40	—
Drainage maxillary antrum	1	2
Tonsils and Adenoids—Enucleation of ...	65	26
Sequestrectomy skull and jaw	4	—
Operation for hare lip, cleft palate ...	10	—
Excision of dermoid and other cysts, glands, new growths, tongue and cervical rib	33	—
Turbineotomy	4	1
Trephining and other operations for depressed fractures, etc.	14	—
Tracheotomy	4	—
Others	24	4
II.—Thorax—		
Laminectomy	2	—
Amputation of breast	3	2
Resection of rib	14	1
Others	4	2
III.—Abdominal—		
Operations on the appendix	95	43
Herniotomy :		
(a) Simple inguinal	120	7
(b) Strangulated inguinal	29	—
(c) Others	11	1
Iliac abscess, etc., drainage	6	—
Intra peritoneal abscess, drainage	8	—
General peritonitis drainage operation ...	15	—
Perforated gastric ulcer suture and drainage	6	—
Anterior gastro-enterostomy	1	—
Posterior gastro-enterostomy	32	1
Posterior gastro-jejunostomy	12	—
Enterostomy, Colostomy, etc.	13	—
Splenectomy	10	—
Laparotomy	26	1
Operations on the gall bladder	13	3
Operations for intestinal obstruction ...	4	—
Liver abscess (amœbic)—drainage operation	7	1
Wounds of abdomen : sutures, etc.	26	1
Others	27	2
IV.—Genito-Urinary—		
Hydrocele-radical cure	45	3
Cystoscopy	8	—
Nephrectomy	1	—
Lithotomy	—	—
External urethrotomy	12	—
Amputation of penis	5	—
Orchidectomy	1	1
Prostatectomy	1	1
Others	8	3

TABLE V—(cont.)

						Asiatics.	Europeans.
V.—Perineal—							
Fissure and fistula-in-ano	...	...	...	...	...	29	5
Imperforate anus	...	...	...	...	...	7	—
Imperforate vagina	...	...	...	...	...	1	—
Hæmorrhoids	...	...	...	...	...	43	8
Vesico-vaginal fistula	...	...	...	...	...	6	—
Others	...	...	...	...	...	4	—
VI.—Limbs—							
Amputations	...	...	...	...	...	40	1
Excision of joints	...	...	...	...	...	4	3
Excision sarcoma by diathermy, etc.	...	...	...	...	...	—	3
Repairs of wounds, etc.	...	...	...	...	...	8	4
Grafting operations	...	...	...	...	...	7	—
Disarticulations	...	...	...	...	...	9	—
Dislocations	...	...	...	...	...	2	—
Operations for osteo-myelitis	...	...	...	...	...	17	2
Operations for deformities	...	...	...	...	...	2	1
Open operations for fractures	...	...	...	...	...	19	1
Excision of ulcers, bursac and new growths	...	...	...	...	...	8	—
Others	...	...	...	...	...	11	—
VII.—Gynæcological—							
Perinæorrhaphy, colporhaphy	...	...	...	...	...	7	1
Pyosalpingitis with pelvic peritonitis drainage	...	...	...	...	...	3	—
Dilatation and curettage	...	...	...	...	...	25	17
Cæsarean section	...	...	...	...	...	12	1
Operations for uterine displacement	...	...	...	...	...	9	6
Salpingo-oophorectomy, etc.	...	...	...	...	...	9	1
Operations for ruptured ectopic gestation	...	...	...	...	...	7	—
Amputation of cervix	...	...	...	...	...	3	—
Hysterectomy	...	...	...	...	...	5	9
Ovariectomy	...	...	...	...	...	10	2
Parovarian cyst-excision	...	...	...	...	...	3	—
Others	...	...	...	...	...	4	—
VIII.—Various—							
Diathermy, rodent ulcer	...	...	...	...	...	—	2
Excision of cysts, tumours, etc.	...	...	...	...	...	—	5
Aneurysm	...	...	...	...	...	1	—
Spina bifida	...	...	...	...	...	1	—

TABLE VI.

Detailed summary of the diseases and major operations at the Ophthalmic Clinics.

	In-patients.	Out-patients.	Total.
I.— <i>Eye Diseases Proper</i> —			
Lids	138	837	975
Conjunctiva	432	4,075	4,507
Cornea	274	601	875
Iris	78	95	173
Lens	215	262	477
Ciliary body	16	79	95
Retina	41	70	111
Sclera	1	2	3
Ocular muscles	7	26	33
Lachrymal apparatus ...	14	51	65
Orbit and neighbouring parts	10	4	14
Glaucoma	36	48	84
II.— <i>Eye Injuries</i>	89	658	747
III.— <i>Refractions</i> —			
Emmetropia	3	28	31
Myopia	4	340	344
Myopic astigmatism ...	—	98	98
Hypermetropia	—	47	47
Hypermetropic astigmatism	—	82	82
Presbyopia	—	286	286
Asthenopia	3	87	90
Other errors of refraction	1	101	102
IV.— <i>General Diseases affecting Eyes</i>	35	46	81
V.— <i>Disorganised Eyes</i> —			
(a) One eye	41	61	102
(b) Two eyes	6	18	24

NATIONALITY.

Europeans	1	335	336
Eurasians	6	184	190
Chinese	754	3,888	4,642
Indians	531	2,274	2,805
Malays	146	1,204	1,348
Others	13	86	99

SEX.

Male	1,078	5,948	7,026
Female	373	2,021	2,394
	<hr/> 1,451	<hr/> 7,969	<hr/> 9,420

CLASSIFICATION OF MAJOR OPERATIONS.

Extraction of cataract	165
Iridectomy	39
Trephining of eyeball	15
Enucleation of eyeball	8
Evisceration of eyeball	19
Others	34
Total	<hr/> 280

APPENDIX I.

ANNUAL REPORT OF THE DIRECTOR, INSTITUTE FOR
MEDICAL RESEARCH, FEDERATED MALAY STATES,
FOR THE YEAR 1931.

I.—STAFF.

Director: A. Neave Kingsbury, M.D., B.S., B.SC. (Lond.), M.R.C.S. (Eng.), L.R.C.P. (Lond.), D.P.H., D.T.M. AND H. (Lond.).

BACTERIOLOGICAL DIVISION.

Bacteriologist: P. H. Martin, M.A., B.M., B.CH. (Oxon.), M.R.C.P. (Lond.), D.T.M. AND H. (Lond.).

Assistant: R. Mukerji, M.B., D.T.M. (Bengal).

PATHOLOGICAL DIVISION.

Pathologist: R. Lewthwaite, M.A., D.M., B.CH. (Oxon.), M.R.C.S. (Eng.), L.R.C.P. (Lond.).

Assistant: S. R. Savor, M.B., B.S. (Madras).

CHEMICAL DIVISION.

Chief Chemist: R. W. Blair, A.R.C.SC.I., F.I.C.

Chemists: J. Shelton, F.I.C. (seconded to T. & C. Dept.);
F. E. Byron, PH.D., B.SC. (Liv.), A.I.C.; I. A. Simpson, PH.D.,
B.SC. (Liv.), A.I.C.

MALARIA RESEARCH DIVISION.

Malaria Research Officers: R. Green, M.D., B.S. (Melb.), D.T.M. (Liv.); J. W. Field, M.D., CH.B. (B'ham).

ENTOMOLOGICAL DIVISION.

Entomologist: E. P. Hodgkin, B.SC. (Vict.).

LYMPH STATION.

K. Kanagarayer, L.M.S. (S'pore.), D.T.M. (Bengal).

IPOH BRANCH LABORATORY.

H. M. Nevin, B.A., M.B., CH.B., B.A.O. (T.C.D.), D.T.M., D.T.H. (Liv.). (Acting).

OFFICE.

Chief Clerk: V. Thamboo

LIBRARY.

Librarian: Seow Tian Kim.

II.—GENERAL.

The shrinkage in public funds consequent upon the present universal economic crisis has not been without influence on the activities of the Institute. During the period under review it has been essential to pursue a policy of rigid economy and even to effect certain reductions in personnel. Early in the year Dr. L. Anigstein was released from his appointment as Research Student to report, on behalf of the League of Nations Malaria Commission, to the Siamese Government on the malaria situation in that country. Since his departure neither of the Research Studentship appointments has been filled. Other economies, of necessity detracting somewhat from smooth working, have been effected among the subordinate staff. Despite this curtailment in expenditure and the usual vast volume of routine examinations, research work, particularly in connection with malaria and tropical typhus, has steadily progressed.

Speculation is justified at the present stage as to the essential factors which determine the carriage of malaria by any one species of anophelines. Under laboratory conditions it has been found possible to infect a large number of species, many of which are apparently harmless under local natural conditions. Dr. R. Green has shown that, of a series of species tested, *A. maculatus* has the greatest avidity for human blood. This finding has been confirmed by precipitin reactions on captured anophelines (though many tests have been undertaken since the end of the year and are not included in the present report). Generally it appears that human blood is to be found in about 85 per cent. of engorged captured *A. maculatus*. With other species, which in nature may occasionally carry, positive reactions for human blood have been obtained in a small percentage only. It would seem that many local anophelines, which can, and sometimes do, carry malarial infection, are not usually of epidemiological importance because they prefer the blood of cattle or of other animals to that of man. Is it therefore desirable to discourage the keeping of domestic animals in proximity to human habitations?

Exception may, perhaps, be taken to the stressing of the importance of tropical typhus. It is true that the mortality from pneumonia and other diseases is much greater than that occasioned by this infection. Yet year by year there has been an increase in the case mortality until the figure approximates to that for endemic typhus fever in Europe. Already too, the number of cases diagnosed serologically, approaches the number of enteric cases so encountered. There has been a gradual spread from endemic foci in Selangor, until a very large part of the State is now infected, and, on an oil-palm estate planted in 1923, which has been kept under observation for several years, the disease has made its appearance and there were no less than 19 cases in the past year. In Negri Sembilan and in Pahang, the number of cases is also increasing.

In the past tropical typhus has occurred only rarely on rubber plantations, but now, that finding no longer obtains. A number of cases have been infected while working among cover crops and secondary growth. The present methods of cultivation with nitrogenous and other cover crops tend to encourage rodents by affording them protection. No such protection exists on a clean-weeded estate. Soil conservation is doubtless essential for successful agriculture, but the introduction of a thinly growing cover is to be advocated. Protection for rats would be reduced and the risk of infection for the labourers would thus be minimised.

The effect of the experimental prophylactic vaccine prepared and given by Dr. L. Anigstein has, over a period of months, been disappointing. Any immunity that resulted from its use is of a fleeting order. It is hoped, however, to produce an "organ" vaccine from vitamin-deficient guinea-pigs, which have proved so susceptible to infection, and to investigate its efficacy.

Protective measures against the vector or vectors of tropical typhus would be difficult of regular application. Apart from the development of successful vaccine prophylaxis, a practicable measure of control lies in the extermination of rats. Our present methods, however, leave much to be desired. Huge numbers are slaughtered annually on the oil-palm plantations, but, when this pest is arboreal in its habits and its food supply cannot be protected, methods such as catching, poisoning, etc., are of little avail in determining any permanent reduction in the rat population. Investigation of viruses from local rats was started just before the end of the year in order to explore the possibilities of this line of attack.

It may appear from a perusal of the Research Section of this report that the contributions from the Chemical Division are relatively few in number. Routine examinations occupy much time in that division, but Dr. F. E. Byron, in collaboration with Dr. A. G. Badenoch, Acting Superintendent, Sungei Buloh Settlement, has been engaged on an investigation of blood calcium in leprosy, and Dr. I. A. Simpson has continued his researches on vitamins.

For the investigation of epidemics occurring at a distance from the laboratories and to facilitate certain researches, a mobile laboratory was designed by Dr. C. Russell Amies in 1930. Delivery of the vehicle was taken in the present year. The laboratory is mounted on a Ford chassis and arranged with benches, sinks, independent water supply, and electric light. The design is such that the interior is relatively dust proof when the vehicle is in transit, and a swinging frame attached to the side provides support for a tarpaulin tent, which, in emergency, could be used for sleeping accommodation. Water is carried in two large tanks slung beneath the chassis, from which it is pumped by hand to a small service reservoir whence it gravitates to the bench supplies. The laboratory has been found most useful in investigations undertaken in Pahang and in the coast district of Selangor.

Attention is invited to the findings by Dr. P. H. Martin in connection with specimens of blood submitted for the Widal reaction. Although the percentage from which enteric organisms were isolated is comparatively small, the results again demonstrate that there is risk in the handling of such specimens, particularly when there is soiling of the outside of the specimen tube and of the inside of the protecting wooden case used in transit through the post. This matter is specially mentioned in order that the danger may be more appreciated by those collecting and forwarding such specimens.

The retirement of Dr. J. E. Lesslar on account of ill-health is recorded with regret. This zealous officer had served in the Medical Department for no less than 31 years and the last 13 years of his service were passed at this Institute as Assistant in the Bacteriological Division. The excellence of his work has been recognised by the award of the M.B.E.

III.—RESEARCH.

MALARIA.

Prophylaxis.

In the previous report preliminary details were noted of an experiment on the prophylactic value of plasmoquine simplex when exhibited twice weekly in an adult dose of 0.04 grammes. It will be remembered that the venue of the experiment was a malarious rubber estate with a population of about 330. Two adjacent estates with populations of 405 and 362 served as controls, and quarterly surveys for parasite and spleen rates, hæmoglobin percentage, and anopheline breeding places were undertaken on the three estates. The experiment, after having been in operation for twelve months was terminated in the present year. During that period the number of anopheline breeding places within half-a-mile of the lines remained fairly constant on the experimental estate, but fell markedly on the control estates. Gauged by these observations the anopheline population remained about constant on the experimental estate, but diminished on the control estates.

As regards sub-tertian malaria, the results, judged from the parasite rates, were somewhat inconclusive, but, towards the end of the experiment, no *P. falciparum* gametocyte carriers were found on the experimental estate. The method of prophylaxis was found to be less satisfactory for benign tertian malaria, and it was concluded that plasmoquine has, perhaps, a less definite gametocidal action on *P. vivax* than on *P. falciparum*.

On the other hand, the effect of the measure on the incidence of clinical malaria was definite. In the twelve months preceding the experiment, the sub-tertian and benign tertian cases totalled 30.4 and 52.5 per cent. of the population on the experimental

estate, i.e., a total of 82.9 per cent. Throughout the experimental period the incidence was 7.0 and 8.7 per cent. for sub-tertian and benign tertian, i.e., a total incidence of 15.7 per cent. only. The fall in the splenic index and the rise in the average hæmoglobin percentage were small, but the improvement in the general physical condition of the labourers was very satisfactory, an observation which was confirmed by the sick rates. The total sick rate fell by 51 per cent. on the experimental estate, by 11 per cent. on one of the control estates, but rose by 21 per cent. on the second control estate.

The cost of plasmoquine prophylaxis as applied in this experiment was about \$600 (Straits) per annum per hundred labourers, including the average number of dependents living with them in the lines. This figure appears high, particularly as plasmoquine prophylaxis can only be recommended at the present time as an adjunct to anti-larval measures. But it is believed that the method will find useful application, particularly in view of the resulting reduction in hospital charges and in the expenditure on quinine.

Quino-plasmoquine.

In a malarious village near Kuala Lumpur there had been a number of cases of clinical malaria among the police force. Permanent anti-malarial work was out of the question, and, in fact, the configuration of the ground is such that oiling and ditching would have involved very heavy expenditure. The question of the protection of the police was referred by the Health Officer, Kuala Lumpur, and it was suggested that quino-plasmoquine might be employed for its prophylactic effect. The police, including dependants, totalled 63, and, at an examination before the commencement of treatment, the spleen rate was found to be 10 per cent. and the parasite rate 5 per cent. The dosage adopted was 2 tablets daily, i.e., 0.02 grammes of plasmoquine plus 0.6 grammes (9 grs.) of quinine. For the first week this preparation was taken daily, but on successive weeks it was taken on Mondays, Tuesdays and Wednesdays only.

Since the application, in October, of this form of prophylaxis there has been one case of sub-tertian malaria in a policeman who was parasite free at the time of the preliminary survey. There is doubt, however, if he had taken the drug regularly. An investigation of the urines, passed by the police, indicated that a number of the men were probably avoiding treatment.

THERAPEUTICS.

During the year several drugs have been submitted to this Institute for testing in regard to efficacy in the treatment of malaria. The therapeutic value of quinine-stovarsol, malarcan, atabrin (erion), and a Chinese drug of unknown composition has been investigated by Dr. R. Green. Including control cases, 169 individuals have been specially treated and observation has been continued after the termination of treatment for periods

varying from a few days to several months. The number of cases, together with the drug and daily dosage, are summarised in the following table:

TABLE I.
DRUGS AND DAILY DOSAGE.

Type of Malaria.	Quinine Bihydrochloride gr. xx.	Quinine Bihydrochloride gr. xxx.	Quinine Bihydrochloride gr. vi.	Quinine-stovarsol gr. xii.	Malarcan 12 tablets.	Atebrin ("Erion") 0.2 to 0.4 gm.
B.T.	10	14	6	13	1	13
S.T.	8	11	1	10	8	18
Q.	9	19	6	12	1	9
Totals	27	44	13	35	10	40

Atebrin ("Erion").

A new preparation, which tentatively was given the name of "erion" and is now to be known as "atebrin", has recently been produced by the makers of plasmoquine. Its composition has not been divulged and, as yet, it is not on the market. Preliminary tests made in Europe show that the drug destroys the parasites of avian malaria and is effective in the treatment of human cases inoculated, for therapeutic purposes, with malaria parasites. It is said to be a synthetic preparation based on a formula evolved by Professor Schulemann.

The supply was received in the form of tablets. The drug is somewhat bitter to the taste and is fairly soluble in water to which it imparts a bright yellow colour. Unlike plasmoquine, but like quinine, it shows fluorescence under ultra-violet radiation.

The investigation of its properties is still proceeding. So far, 40 cases of malaria have completed seven days treatment. Subsequently the patients have been kept under daily observation for as long as possible. The 40 cases included 13 benign tertian, 18 sub-tertian, and 9 quartan infections, and consisted of male Tamils, Chinese and Sikhs whose ages varied from 6 to 50 years. Control cases were treated with quinine bihydrochloride (30 grains daily) and the results obtained are given below in tabular form:

TABLE II.
COMPARISONS OF PARASITOCIDAL PROPERTIES.

	Quinine.		"Erion."	
	Gr. xxx daily (2.0 gm.)		Gr. iii to gr. vi daily (0.2 to 0.4 gm.)	
Average number of days parasites persisted in the blood (thick films)	B.T. (10 cases)	3.4 days	B.T. (13 cases)	2.3 days
	* S.T. (10 ")	2.8 "	* S.T. (18 ")	3.7 "
	* Q. (18 ")	5.9 "	* Q. (8 ")	4.9 "

TABLE III.
THE DURATION OF FEVER.

	Quinine.		"Erion."	
	Dosage as above.		Dosage as above.	
Average period of persistence of fever (temperature 99°F. or over) from the commencement of treatment.	B.T. (10 cases)	1.8 days	B.T. (12 cases)	1.9 days
	S.T. (10 ")	1.8 "	S.T. (16 ")	1.8 "
	Q. (10 ")	2.8 "	Q. (9 ")	2.4 "

* Trophozoites and schizonts only.

TABLE IV.
RELAPSES AFTER TREATMENT.
(Reappearance of parasites in the blood, with or without symptoms, was regarded as relapse.)

Form of infection.	No. of cases observed.	Period of observation after treatment ceased.		Proportion of relapses.	Percentage of relapses.
		Limits.	Average.		
Quinine.					
Gr. xxx for seven days.					
B.T.	13	3 to 28 days	10.1 days	5/13	38.4%
S.T.	15	5 to 21 "	12.3 "	3/15	20.0%
Q.	19	4 to 46 "	18.5 "	5/19	26.3%
" Erion."					
Gr. iii to vi for seven days.					
B.T.	11	3 to 47 days	11.7 days	0/11	0.0%
S.T.	14	3 to 17 "	8.1 "	0/14	0.0%
Q.	6	8 to 30 "	16.3 "	0/6	0.0%

The exhibition of plasmoquine brings about a reduction in the number of sub-tertian gametocytes in peripheral blood and also tends to prevent their development within the anopheline mosquito. On the other hand, quinine seems to have little direct action on crescents either in regard to numbers or viability. During the present investigation the action of "erion" on gametocytes has been found similar to that of quinine; it causes a fairly rapid disappearance of the gametocytes of *P. vivax* and *P. malariae* but appears to have little, if any, effect on the gametocytes of *P. falciparum*. As regards viability, the following table shows that the gametocytes of *P. vivax* and *P. falciparum* still continued to develop within anophelines as far as the sporozoite stage despite treatment of the cases with quinine or "erion".

TABLE V.
NEGATIVE EFFECT OF QUININE AND "ERION" ON THE VIABILITY OF GAMETOCYTES.

Gametocyte carriers of.	No. of gametocytes in blood (per cub. mm.).	No. of days of treatment.	Total quantity of drug given.	Mosquitoes infected (öocysts and sporozoites).	Remarks.
<i>P. vivax</i> ...	Quinine. (Gr. xxx daily.)				
	58	1.3 days	40 grains	<i>A. maculatus</i>	One dose of drug given 15 minutes prior to feeding mosquitoes
<i>P. falciparum</i> ...	277	13 "	390 "	<i>A. maculatus</i>	Do.
	"Erion." (0.2 to 0.4 gm. daily.)				
<i>P. vivax</i> ...	1300	1.3 days	0.3 gm. 4.5 grains	{ <i>A. hyrcanus</i> <i>var. sinensis</i> <i>A. subpictus</i> <i>var. mal. ...</i> }	Do.
<i>P. falciparum</i> ...	6440	7 "	2.8 gm. 43 grains	{ <i>A. vagus</i> ... <i>A. kochi</i> ... <i>A. aconitus</i> ... <i>A. philippi-nensis</i> ... }	Do.

Cases treated with "erion" or with quinine have shown similar progress in regard to hæmoglobin regeneration, increase in body-weight and in the rate of reduction in the size of the spleen.

Tests with Mayer's solution indicated that although an aqueous solution of "erion" causes the formation of a precipitate, the urine of patients taking the drug fails to do so. This reagent, however, causes the appearance of a yellowish fluorescence in the urine of "erion" treated patients; the preparation may also be detected in the urine by extraction with ether, to which is imparted the characteristic yellow colour. There appears to be some tendency for the drug to accumulate within the body and to be excreted slowly. Traces have been found in the urine up to the sixth day after the cessation of treatment.

In the dosage employed no case of albuminuria has been observed, and comparatively large doses have given rise to no marked toxic symptoms. Certain cases have complained of abdominal pain, and, in some patients, the skin and sclerotics have become yellow three or four days after the commencement of treatment, but this tinge has disappeared within a few days after the withdrawal of the drug. The yellow discolouration appears to be due to the dyeing effect of the drug on the tissues and not to jaundice—Van den Berg's test on the sera of patients after six days treatment yielded negative results. In view of the toxic symptoms which occur in a small percentage of cases treated with plasmoquine, it is desirable closely to observe a large number of "erion" treated cases before making a definite pronouncement in regard to toxicity.

The enquiry is proceeding and further questions to be investigated are the histological changes following exhibition to animals, the treatment of children, the treatment of Europeans, combination of "erion" and plasmoquine, the mass treatment of estate labour, etc.

To sum up, 40 cases have now been treated with this new synthetic drug. It compares favourably with quinine on all counts except in the rate of destruction of the trophozoites of *P. falciparum*. The drug is not unpleasant to take and no marked toxic symptoms have yet been observed, though a temporary yellow discolouration of the skin and sclerotics sometimes occurs. The dosage employed was about one-seventh of that for quinine.

Quinine-stovarsol.

Work on this drug has been continued, and comparisons made with cases of sub-tertian, benign tertian, and quartan malaria, treated with quinine-stovarsol, 0.75 grammes (12 grains) quinine bihydrochloride, equivalent in dosage to that contained in the quinine-stovarsol, i.e., 0.37 grammes (6 grains); 20 grains of quinine bihydrochloride and 30 grains of quinine bihydrochloride daily.

The results of these treatments have been compared with reference to the rate of disappearance of parasites; the occurrence of relapses; the relief of symptoms; gametocidal properties; the reduction in the size of the spleen, and the increase in hæmoglobin percentage and in the number of erythrocytes.

The general conclusions may be briefly stated as follows: The stovarsol contained in quinine-stovarsol has a definite parasitocidal effect on *P. vivax*. Twelve grains of quinine-stovarsol daily is as effective in benign tertian cases as 20 or 30 grains of quinine, but the former drug has the disadvantage of being less efficacious in quartan and sub-tertian malaria and is therefore of little use in apparent, or concealed, cases of mixed infections. Further, hyperperexia and exacerbation of symptoms may occur during the first twenty-four hours of treatment in all three types of malaria infection. It is not superior to quinine in regard to the prevention of relapses, and is without action on sub-tertian gametocytes. One crescent carrier, after continuous treatment with quinine-stovarsol for 25 days, infected anopheline mosquitoes, and hence the drug can have little effect on the viability of the sub-tertian gametocyte. With these disadvantages there appears to be little place for quinine-stovarsol in tropical practice, particularly as the preparation is about five times more costly than quinine.

Malarcan.

This preparation is said to have the formula methyl-acridine-methyl-cupreine-dehydrocholate; that is, a compound of a stereo-isomeric base of methyl-cupreine (quinine contains methyl-cupreine as part of its structural formula while the stereo-isomer of quinine is quinidine) combined with methyl-acridinium-chloride and dehydrocholic acid. Malarcan, in high dilutions, like quinine, shows fluorescence under ultra-violet light.

The preparation has been advertised for the treatment of malaria, and enquiries concerning it have been received from medical practitioners and from an importing firm. A supply was obtained sufficient for the treatment of ten cases, including one quartan, one benign tertian, and eight sub-tertian infections. Twelve tablets of malarcan were found to alleviate symptoms and to destroy parasites as effectively as quinine in a dosage of 30 grains. Cases were treated for from 7 to 14 days and subsequently kept under observation for periods ranging from one to six weeks. No relapses were observed. The effect on the gametocytes of *P. falciparum* was, however, negligible and, in view of the fact that the cost of malarcan is approximately six times that of quinine, it is unlikely that its use will become general.

Control Cases Treated with Quinine.

Quinine was exhibited to control cases in a daily dosage of 30 grains of the bihydrochloride, and certain points of interest have been noted from a close study of the cases. Quartan trophozoites and schizonts may persist in the peripheral blood

for two days after the completion of seven days treatment. In similarly treated cases, quartan gametocytes were demonstrated in the peripheral blood five days after the cessation of the course.

Careful measurement has shown that in some cases the spleen becomes larger during the first two days of treatment, but subsequently, with the disappearance of parasites, its size diminishes. This initial enlargement may be due to the increased activity in destroying quinized parasites and damaged red cells.

Despite preliminary purgation, the absorption of quinine during the first three or four days of treatment appears sometimes to be irregular, if gauged by the quantity excreted in the urine. The disappearance of parasites from the peripheral blood is delayed in such cases.

When patients first came under observation, the parasites found in the peripheral blood may have been sub-tertian or quartan. But, after a relapse, benign tertian parasites only have not infrequently been found. Similar observations have been made by Fletcher in this country and by others elsewhere. The finding indicates that an unexpectedly large number of malarial infections in Malaya are, in fact, mixed, but, during the acute stage, one type or another dominates the picture and is the only one identified. The other type of parasite probably sporulates quietly in the blood stream and occurs in such small numbers that it is not evident in either thin or thick films.

A Chinese Drug of Unknown Composition.

A Chinese preparation, which had achieved a local reputation for the treatment of malaria, was kindly forwarded for testing by Dr. Ansley Young of Klang. The preparation appeared to be a galenical decoction or infusion. It had a taste rather similar to flat toddy, and, when tested for alkaloids by Mayer's reagent, a negative result was obtained. The directions mentioned that vomiting was induced, but that this symptom was of no moment and that a single dose would cure an attack. The preparation was tested on a benign tertian case. Severe vomiting occurred half an hour after the drug had been swallowed; subsequently, no curative effect, that could be ascribed to the drug was observed. Parasites continued in the peripheral blood, and it was concluded that the preparation was useless in the treatment of benign tertian malaria.

THE CONSUMPTION OF DIFFERENT FORMS OF CINCHONA ALKALOIDS.

An enquiry has been made relative to the consumption of cinchona alkaloids in the Federated Malay States. The following figures are based on the requirements from 1922 to 1930, but, in view of the prevailing financial stringency, it is

probable that the quantities for the year under review will probably be rather smaller. The annual consumption in the Federated Malay States is roughly about 5,000 lbs. of cinchona alkaloids, of which about 1,000 lbs., in the form of quinine hydrochloride tablets, is distributed, free of charge, by the Health Authorities. Of the remainder, Government hospitals and dispensaries use rather less than half, and the rest goes to estates, mines, and private individuals.

The following table shows the relative quantities of the soluble and less soluble salts of quinine which have been consumed locally over a number of years:

TABLE VI.
CONSUMPTION OF THE VARIOUS SALTS OF QUININE.

—	Quinine sulphate and bisulphate.	Quinine hydrochloride and bihydrochloride.
Government departments (8 years)	1,006 lbs. (quinine sulphate only)	18,115 lbs.
Proportions	1	18
Private firms supplying rubber estates, etc. (6 years) ...	9,800 lbs. (approx.) (both sulphate and bisulphate)	3,800 lbs. (approx.)
Proportions	2.6	1

Of the 18,100 lbs. of the more soluble salts of quinine which has been used in the past eight years, 10,200 lbs. was bihydrochloride powder; 150 lbs. hydrochloride powder; and 7,800 lbs. hydrochloride tablets. The solubilities in water of the bihydrochloride, hydrochloride, bisulphate, and sulphate are 1/1, 1/40, 1/11 and 1/800 respectively. The local cost of the alkaloids varied somewhat in 1925 and 1926, but since then has remained about constant. The present approximate price per ounce is as follows:

Quinine sulphate and bisulphate	... ..	20d.
Quinine hydrochloride and bihydrochloride	...	27d.
Cinchona febrifuge	... ..	11d.

Cinchona Febrifuge.

Cinchona febrifuge was used locally in maximum amounts following Fletcher's publications on its therapeutic value (1921 and 1922). Since then its consumption has declined markedly in Government hospitals and also, though in a less degree, on plantations. The following table gives the approximate quantities consumed during the years 1923 to 1930 inclusive.

TABLE VII.

ANNUAL CONSUMPTION OF CINCHONA FEBRIFUGE.

Year.				Government departments.	Estates, etc.	
1923	...	...	...	794 lbs.	...	—
1924	...	...	...	476 „	...	—
1925	...	...	...	210 „	...	175 lbs.
1926	...	...	...	56 „	...	250 „
1927	...	...	...	61 „	...	144 „
1928	...	...	...	40 „	...	200 „
1929	...	...	...	40 „	...	38 „
1930	...	...	...	69 „	...	94 „

The chief objections to cinchona febrifuge are its varying composition and the trouble in dispensing. Solutions must be rendered more acid to ensure solution than is the case with quinine sulphate, and unless carefully filtered, are often slimy and unpleasant. Further, cinchona febrifuge contains a large proportion of amorphous cinchona alkaloids (Indian febrifuge, 45 per cent.; Java febrifuge, 37 per cent.) and these amorphous alkaloids are relatively toxic and liable to produce vomiting, dizziness, etc. It not infrequently happens that the Tamil estate labourer refuses to swallow this preparation.

Totaquina.

The Malaria Commission, Health Organisation, League of Nations, have recognised the disadvantages of cinchona febrifuge and have discussed ways and means for the production of a similar preparation, equally cheap, somewhat more effective, but less toxic. From this discussion a proposal for a new preparation "Totaquina" has arisen. It is to be a composition of the various alkaloids of cinchona but is to contain 70 per cent. of the crystalline alkaloids, while amorphous alkaloids are not to exceed 20 per cent. Totaquina will be a fine, yellowish white powder, comparing favourably in appearance with cinchona febrifuge and making better mixtures. If this new product can be manufactured at the same price as cinchona febrifuge it will reduce the general cost of treatment of malaria by about one-half, provided that it proves therapeutically efficacious and that an amorphous alkaloid content of 20 per cent. is not found to be unduly toxic.

**THE DETECTION OF CERTAIN DRUGS IN SOLUTION BY
ULTRA-VIOLET LIGHT AND BY MAYER'S REAGENT.**

The drugs investigated were plasmoquine, "erion," and quinine bihydrochloride. Watery solutions were made in ascending dilutions and examined under ultra-violet light by Dr. R. Green. Subsequently Mayer's reagent was added to the tubes. The results obtained are embodied in Table No. VIII from which it will be seen that Mayer's reagent affords evidence of the presence of the drugs in very high dilutions. With

ultra-violet light, plasmoquine gave negative results, but “erion” reacted similarly to quinine, and with both these drugs there was a curious increase in fluorescence over a range of the higher titres. After a dilution of 1/6,400 the greenish colour of the quinine solution changed to a pale violet, which remained about constant in intensity even up to a dilution of 1/409,000.

TABLE VIII.

Dilutions.		Plasmoquine.		“ Erion.”		Quinine bihydrochloride.	
		Mayer's reagent.	Ultra-violet light.	Mayer's reagent.	Ultra-violet.	Mayer's reagent.	Ultra-violet light.
1 in	100 ...	++	...	...	++	...	+
1 „	200 ...	++	...	...	++	...	+
1 „	400 ...	++	...	...	++	...	+
1 „	800 ...	++	...	...	++	...	++
1 „	1,600 ...	++	...	...	++	...	++
1 „	3,200 ...	++	...	...	++	...	++
1 „	6,400 ...	++	...	...	++	...	+++
1 „	12,800 ...	++	...	...	++	...	±
1 „	25,600 ...	++	...	...	+	...	±
1 „	51,200 ...	+	...	...	+	...	±
1 „	102,400 ...	+	...	...	±	...	±
1 „	204,800 ...	+	...	...	±	...	±
1 „	409,600 ...	±	...	...	±	...	±
1 „	818,200 ...	±	...	...	±	...	-
1 „	1,636,400 ...	-	...	...	-	...	-

In patients undergoing treatment with plasmoquine (up to a dosage of 0.06 gm. daily) it has not been possible to obtain positive results by adding Mayer's reagent to the urine; for its detection the complicated chloranil test has been found necessary. Even this test must be undertaken on eight-hour collections of urine as negative results have been obtained when smaller quantities have been employed. Little plasmoquine is excreted in the urine and it seems probable that metabolism occurs within the body.

Experimentation with “erion” and quinine solutions and ultra-violet light was undertaken to explore the possibility of detection by this means of the drugs in the urine. The method, however, has no practical application as it has been found that specimens of urine for normal untreated individuals show some fluorescence under ultra-violet light. Unless the substance in normal urine, responsible for this fluorescence, can be removed ultra-violet radiation is useless for the detection of the excretion of fluorescent drugs in the urine.

Plasmoquine and Quinine.

A report was received that the urine of a patient, taking plasmoquine with quinine, persistently failed to show a precipitate with Mayer's reagent. When plasmoquine was withdrawn but quinine continued a positive reaction was said to have been obtained. It was suggested that plasmoquine might interfere with the absorption and excretion of quinine.

The finding was contrary to previous experience at this Institute, but in order to test the hypothesis an investigation was made of three cases "A", "B" and "C". For a period of seven days "A" received quinine only, "B" was given quinine and 0.04 grammes of plasmoquine, while "C" received quinine and 0.03 grammes of plasmoquine. Before, during, and after these treatments the urines were tested at two-hourly intervals by means of Mayer's reagent. No essential difference was found; the urine of all three cases gave positive reactions. In the cases "B" and "C", the exhibition of plasmoquine did not interfere with the absorption and excretion of the quinine.

THE LABORATORY DIAGNOSIS OF MALARIA.

Further investigations on the relative merits of thin and thick blood films have been continued by Dr. R. Green with a view to the adoption of simple and effective methods of staining which would eliminate the drawbacks inherent in the use of Romanowsky's stains in this and similar climates. The use of buffered solution for both thick and thin films obviates the necessity for distilled water and corrects any slight acidity of the methyl alcohol or glycerine. The water used, however, must be soft and free from excessive organic material. The results are constant and the final picture leaves nothing to be desired. A Bulletin on this subject has been issued for use in hospital and estate practice, and demonstration specimens of thick films of the different parasites have been supplied to some 300 individuals.

THE RELATIVE NUMBERS OF PARASITES IN CAPILLARY AND VENOUS BLOOD.

Careful counts have been made, prior to the commencement of treatment, of the number of parasites in capillary blood from the finger and in venous blood obtained by venipuncture. The results obtained are given in the following table:

TABLE IX.

Type of infection.	No. of cases examined.	Average count from blood of finger. (per cub. mm.)			Average count from blood of vein. (per cub. mm.)		
		Troph.	Schiz.	Gam.	Troph.	Schiz.	Gam.
Sub-tertian ...	56	16,630	0	1,561	16,026	0	1,223
Benign tertian ...	17	2,994	1,897	129	3,643	2,125	125
Quartan ...	12	1,308	228	43	1,190	257	31

The greater number of crescents in the capillary blood may indicate a tendency to accumulation in the capillary circulation. In experiments on anopheline infection, gametocyte counts should thus preferably be made from capillary rather than from venous blood.

PARASITE AND SPLEEN SURVEYS.

Parasite and spleen surveys have been undertaken on the Tamil populations of six rubber estates. For purposes of comparison, similar surveys have also been made on groups of Sakai. The latter were chosen to afford an indication of the degree of malarial infection among an unprotected population.

These people seldom, if ever, take quinine and must acquire some degree of natural immunity to malarial infection. The following table gives the spleen and parasite rates:

TABLE X.
ESTATE LABOURERS.

Estate.	No. examined.	Spleen rate, per cent.	Parasite rate, per cent.
A ...	182	43	32
B ...	25	32	24
C ...	144	17	18
D ...	228	0.9	8
E ...	285	4	7
F ...	313	0.6	3
Total ...	<u>1,177</u>	Average <u>16</u>	Average <u>15</u>

Sakai.

Locality.	No. examined.	Spleen rate, per cent.	Parasite rate, per cent.
A ...	21	38	38
B ...	45	31	29
C ...	55	16	20
D ...	17	19	35
E ...	12	17	25
F ...	15	33	20
Total ...	<u>165</u>	Average <u>26</u>	Average <u>28</u>

The Sakai were examined in small groups from six different localities in three of the four States of the Federation. By this means it was possible to obtain representative figures of the types of infecting parasites. The distribution of the types was as follows:

	S.T.	B.T.	Quartan.	Mixed infections.
Estate labourers ...	4	3	3.5	1
Sakai ...	3	1	3	1
1,000 hospital cases (for comparison) ...	20	8	5	1

The proportionately smaller incidence of quartan malaria among the Sakai, as compared with estate labour, does not support the view, recently put forward by certain investigators in India, that the incidence of quartan malaria is high among primitive and jungle-dwelling peoples.

On estates, the adults were more heavily infected than the children and, to this finding there was only a single exception among the groups of Sakai. The spleen rate for adults was found to be of little value in assessing the degree of malarial infection and though, on certain estates, the splenic index among children gave some indication of the parasite rate, on others, it was found to be quite unreliable as a guide. Frequently, in cases with enlarged spleens, no parasites could be found in blood films, and, when blood findings were positive, the spleen, particularly in adults, was not palpable.

The finding from India that the gametocyte rate for children is frequently higher than that for adults, and hence that children are particularly dangerous from the point of view of the infection of anophelines, has not been uniformly confirmed. While on some estates the gametocyte rate among children was the higher, on other estates, opposite conditions obtained.

The number of cases of clinical malaria among an estate population may give little indication of the parasite rate. From the above and previous investigations, it has been established that clinical malaria may be practically absent, although the parasite rate is from 8 or 10 per cent.

MALARIA IN MALAYAN MONKEYS.

A paper has been published by Dr. R. Green, on his investigations of the malarial parasites found in local monkeys, in which the parasite, commonly found in the Malayan macaque—*Macaca irus* (*M. cymologus*), was described. The plasmodium closely resembled *P. vivax* and was identified as *P. inui*, Halberstädter and Prowazek, 1907. About one-quarter of the monkeys examined have been found to be infected, and the parasite was readily inoculable to other monkeys of the same species. It persisted for many months in the peripheral circulation of naturally and artificially infected animals, the disease running a benign course.

Daily observations on the production of trophozoites and gametocytes in artificially infected monkeys were made for a period of ten months. Trophozoites persisted throughout, but the gametocytes showed periods of maximum production at intervals of nine and twenty-four days after inoculation. Fluctuations in trophozoite and gametocyte counts ran approximately parallel in three inoculated animals, but no relationship was apparent between these fluctuations and changes in meteorological conditions.

Culicine mosquitoes and the monkeys' lice were insusceptible to infection, but development occurred in *A. kochi*, *A. maculatus* and *A. vagus* after feeding on monkeys which had been inoculated with infected blood. Infection of these anophelines was possible from twelve to twenty-nine days after the injection of the monkeys. In appearance and in the rate of development the oöcysts were indistinguishable from those of *P. vivax*, and the sporozoites were similar to those of *P. falciparum* and *P. vivax*.

Injections, into monkeys (*M. irus*), of sporozoites of *P. falciparum* and of blood from a patient infected with *P. vivax* were attended with negative results, and the preliminary injection, into a monkey, of some 55,000 sporozoites of *P. falciparum*, failed to influence the clinical course of malaria consequent upon the later inoculation of blood containing *P. inui*.

LARVICIDES.

An investigation, commenced by Mr. G. H. Corbett, and continued by Mr. E. P. Hodgkin, is proceeding on the larvicidal properties of mineral oils. It has been customary to specify that

an oiling mixture for anti-larval use should consist of a certain volume ration of "heavy", "solar", and "light" oils. These terms are employed for trade purposes, and any one grade may, and frequently does, include oils of very different physical and chemical properties.

A number of oil samples of the grades commonly in use, were kindly supplied by one of the local oil companies. Two were described as "heavy" oils one as "solar", and the remaining six as "light" oils. A large number of experiments have been made to test the toxicity to mosquito larvae of these oils, and of various mixtures of them, when used as films on water. From the results certain mixtures have been prepared, which, by the courtesy of a number of health officers, visiting medical practitioners, and estate managers, are now being used for field experiments. It is hoped that these experiments will lead to the selection of a cheaper standard anti-malarial mixture with enhanced larvicidal properties.

In laboratory experiments, light oil No. 5 was found to be the most rapidly toxic of the light oils. It has a high viscosity and specific gravity, a wide range of volatility, and is the least pure. Of the two heavy oils, No. 2 was the most satisfactory, probably on account of its greater fluidity. The results of the laboratory tests, which have been incorporated in a Bulletin, show that a commercially impure oil, of comparatively low viscosity, is probably the most suitable. But the selection of an anti-malarial mixture is complicated by the necessity that the film must have a high immediate toxicity combined with good lasting qualities. An experiment of particular interest was carried out in which fresh larvae were exposed to oil films on six successive days after they had been prepared. Two of the mixtures, both containing heavy oil in the proportion of about 2 parts to 3 of the mixture, retained their toxicity better than either heavy oil alone, or mixtures containing a high percentage of solar oil. Both solar and light oils alone rapidly lost toxicity.

TABLE XI.
ANALYSIS OF OIL SAMPLES.

Sample No.	Heavy.		Solar.	Light.					
	1	2	3	4	5	6	7	8	9
Specific gravity at 15°C. ...	.94	.92	.90	.85	.94	.83	.83	.81	.81
Engler viscosity at 30°C. ...	3.70	1.70	1.40	1.03	1.20	1.03	1.03	1.08	1.07
Flash point °C. ...	85	95	95	60	100	40	40	65	50
Colour ...	Black	Black	Red-brown	Colourless	Red-brown	Colourless			
A.S.T.M. Distillation.									
Up to 200°C. % ...	...	...	...	25	...	60	60	3	25
250°C. % ...	10	10	10	90	40	...	...	90	80
300°C. % ...	40	60	65	...	90	...	...	...	...
Average volatility °C.	315	290	285	215	260	195	195	223	223
Aromatic content per cent. by weight ...	40	35	40	40	60	Highly naphthenic		24	15

The effect of the mixtures, selected for field experiments, on larvae in the laboratory is shown below:

TABLE XII.
EXPERIMENTS WITH SELECTED MIXTURES.
(Five hundred larvae of *A. vagus* used for each oil or mixture.)

Mixture No.	Proportions of oil samples.			Larval deaths per cent. Time in hours.								
	Heavy No. 2	Solar No. 3	Light No. 5	$\frac{1}{2}$	1	$1\frac{1}{2}$	2	$2\frac{1}{2}$	$3\frac{1}{2}$	$4\frac{1}{2}$	$5\frac{1}{2}$	$6\frac{1}{2}$
A 4	2	1	0	55.2	77.6	89.4	92.2	93.8	96.2	97.2	98.0	99.2
B 4	12	0	1	52.6	68.2	78.6	86.2	90.2	94.0	96.8	98.6	99.8
D 1	3	9	1	71.2	90.0	95.4	97.6	98.0	98.6	99.6	99.8	100.0
D 3	8	4	1	63.0	79.0	86.4	91.0	93.2	97.2	98.8	99.2	99.8
Controls.												
	Heavy oil, No. 2			39.0	64.0	76.2	83.0	88.4	95.4	97.0	98.4	99.8
	Solar oil, No. 3			60.4	86.6	94.4	97.4	98.2	99.0	100.0	...	...
	Light oil, No. 5			86.8	96.8	99.2	99.6	99.6	99.8	99.8	100.0	...

Considerable variation has been noted in the resistance of the larvae of different species to the toxic action of oil films. One hundred and twenty larvae of *A. vagus* and of *A. maculatus* were employed in each experiment of a series with the selected mixtures. The percentage of larvae killed in the stated time intervals is shown below; it will be noted that the larvae of *A. maculatus* are considerably more resistant than the larvae of *A. vagus* to the toxic action of all the mixtures.

TABLE XIII.
COMPARISON OF THE LARVICIDAL ACTION OF OILS ON *A. vagus*
AND *A. maculatus* LARVAE.
(One hundred and twenty larvae used with each oil or mixture:
for particulars of mixtures see the preceding table.)

—		<i>A. maculatus.</i>						<i>A. vagus.</i>					
		Larval deaths per cent. Time in hours.						Larval deaths per cent. Time in hours.					
		$\frac{1}{2}$	1	$1\frac{1}{2}$	2	$2\frac{1}{2}$	3	$\frac{1}{2}$	1	$1\frac{1}{2}$	2	$2\frac{1}{2}$	3
Mixture A 4	...	23.5	36.0	58.5	71.0	79.5	83.0	61.5	88.5	96.0	99.0	99.0	100.0
„ B 4	...	27.5	38.5	57.0	68.5	77.0	79.5	53.5	67.5	75.0	82.0	85.0	88.0
„ D 1	...	36.0	61.0	77.5	85.5	92.0	92.0	58.5	88.5	94.0	97.0	97.0	97.0
„ D 3	...	24.5	44.0	63.0	73.5	83.0	84.5	61.5	82.0	93.0	98.5	98.5	98.5
Heavy oil No. 2	...	20.0	52.5	63.5	76.0	80.5	86.5	44.0	66.5	78.5	85.5	89.5	95.0
Solar oil No. 3	...	40.0	62.5	79.5	88.0	91.0	93.0	43.0	82.5	94.0	97.0	98.0	99.0
Light oil No. 5	...	57.5	78.0	85.0	91.0	92.5	93.0	86.5	97.5	99.0	100.0	...	...

Iron Pyrites.

The investigation of the larvicidal properties of iron pyrites, which was briefly noted in the previous report, has been continued. Quantities of iron pyrites have been periodically added to drains on an estate, and larval surveys have been carried out at

intervals of about 2 to 3 weeks throughout the year. The presence of iron in the water was not noticeable to any marked degree, and an analysis, made by Mr. R. W. Blair, of water taken from the treated drains, showed a content of 0.6 parts Fe per 100,000. Breeding was, however, considerably less than in the control drains, and the *A. maculatus* larvae occurred only at the heads of the drains where there was considerable seeping, and where the water was in contact with the pyrites for a very short period.

TABLE XIV.
DRAINS TREATED WITH IRON PYRITES AND CONTROLS.
(Numbers of larval breeding places found.)

Survey.	Total anophelines.		<i>A. maculatus.</i>		<i>A. kochi.</i>		Culicines.		Treated area.
	Treated.	Control.	Treated.	Control.	Treated.	Control.	Treated.	Control.	
1930.									
July ...	2	...	2	All drains treated.
August ...	2	...	2	...	...	...	...	...
	4	8	4	4	2	3	...	...
September ...	2	17	1	5	1	12	...	...
	6	15	2	4	5	11	...	...
October ...	1	1	1	1	Do.
	...	2	...	...	...	2	...	...
	...	5	...	...	...	5	...	...
November ...	1	5	1	...	...	5	...	...
	1	5	1	1	...	5	...	...
	...	3	...	1	...	2	Some drains treated. Do.
	1	4	...	...	1	4	2	...
December ...	2	4	...	...	2	4	...	1
	2	4	1	...	1	4	1	...	
	...	...	...	...	...	...	...	1
	1	2	1	2	2	2	
1931.									
January	Do.
	2	...	...	...	2	...	1	1
	...	4	...	1	...	3	3	1	
February ...	1	5	...	1	1	4	1	...	Do.
	2	6	1	3	1	3	...	...
March ...	1	8	1	7	...	2	4	...	
	1	14	...	8	1	6	2	...	One drain treated.
April ...	1	10	1	8	...	2	2	2	
	1	10	1	8	...	2	2	1	
May ...	2	8	2	8	1	1	Do.
	1	8	1	8	...	...	1	2
June ...	1	5	1	2	...	3	...	...
	
July ...	2	1	1	1	1	...	1	...	
	1	2	1	1	...	2	1	2	
August ...	1	4	1	1	...	3	1	1	
	1	7	1	3	...	4	1	2	
September ...	1	2	1	...	...	2	...	1
October ...	2	2	1	1	1	1	3	...	
	...	2	...	...	...	2	1	2
November ...	1	5	1	2	...	3	...	...
	1	1	1	1	
December ...	...	...	...	...	...	...	...	...
	...	1	...	...	...	1	2	...
Totals ...	48	180	31	78	20	104	32	20	

A. HYRCANUS AS A VECTOR OF MALARIA.

At the request of the Health Officer, Kuala Lumpur, an investigation was instituted by Mr. E. P. Hodgkin into the cause of the malaria in the Brickfields Road area of the town. Sporadic cases have occurred in this neighbourhood for many years, and the importation of infected anophelines by trains and migration from rubber estates about a mile distant, have been suggested as possible causes. Larval surveys in the neighbourhood revealed only one small breeding place of *A. maculatus* that was of a temporary nature, while larvae of no other species, which commonly carries, were found. Larvae of *A. hyrcanus* and *A. vagus* were found in about equal numbers, the former slightly predominating, and larvae of *A. barbirostris* and of *A. philippinensis* also occurred. At the commencement of July, trapping by means of the human-bait-mosquito-net trap was commenced, and was continued until the end of August. Anophelines so caught were dissected and the mid-guts and salivary glands examined. The species caught in the trap were in very different proportion to that found in the larval surveys. About 90 per cent. were *A. hyrcanus*, only about 7 per cent. were *A. vagus*, and the remaining 3 per cent. included *A. barbirostris*, *A. philippinensis*, and *A. kochi*. The results of the mosquito dissection are shown below:

TABLE XV.
DISSECTION OF MOSQUITOES FROM BRICKFIELDS ROAD AREA.

	July.			August.			Percentage infection.
	Total.	Positive.		Total.	Positive.		
		Mid-guts.	Salivary Glands.		Mid-guts.	Salivary Glands.	
<i>A. hyrcanus</i> var. <i>niger-rimatus</i>	191	8	5	9	1	...	7
<i>A. hyrcanus</i> var. <i>sinensis</i>	83	3	1	26	...	1	4.5
<i>A. vagus</i>	12	...	...	20	...	...	...
<i>A. barbirostris</i>	4	...	...	...	...	...	...
<i>A. philippinensis</i>	1	...	...	1	...	...	...
<i>A. kochi</i> ... ..	...	...	...	1	...	...	...

Of the 300 anophelines dissected in the first month, 17—all *A. hyrcanus*—were found to contain oöcysts or sporozoites. These results left no doubt as to the cause of the malaria in the area. Immediate steps were taken by the Health Authorities to drain or fill in the swamps which were the chief breeding grounds of *A. hyrcanus*. Though essential from the point of view of the health of the town, this action was unfortunate in regard to the continuation of the investigation. During the month of

August only 57 anophelines were caught, and towards the end of that month an average of only one *A. hyrcanus* was taken every third night. With such catches, the investigation was necessarily discontinued.

The results, however, show very definitely that under favourable circumstances, *A. hyrcanus* (both *var. nigerrimus* and *var. sinensis*) may function locally as vectors; but, on account of the short period of observation, it is impossible to evaluate their importance as carriers. All specimens of both varieties from other areas of the town and from the surrounding country, have, on dissection been found un-infected.

THE DEVELOPMENT OF MALARIAL PARASITES WITHIN MALAYAN ANOPHELINES.

In the course of mosquito infection experiments, if death of an insect occurs on the ninth day and onwards, the salivary glands are examined as well as the mid-gut. In cases of survival, these glands are examined on the eighteenth day after the blood meal. From the intermediate dissections data has been obtained by Dr. R. Green, regarding the comparative rate of development of the various types of parasites in most of the species employed. The findings from the dissections are shown below:

TABLE XVI.

DEVELOPMENT OF MALARIAL PARASITES.

Plasmodium.	Anopheline.	Earliest day of invasion of salivary glands by sporozoites.
<i>P. falciparum</i> ...	<i>A. kochi</i> ...	11
„ ...	<i>A. maculatus</i> ...	12
„ ...	<i>A. vagus</i> ...	14
„ ...	<i>A. philippinensis</i> ...	15
<i>P. vivax</i> ...	<i>A. kochi</i> ...	16
„ ...	<i>A. maculatus</i> ...	16
<i>P. inui</i> ...	<i>A. kochi</i> ...	16
„ ...	<i>A. maculatus</i> ...	17

The opportunities for observing the rapidity with which sporozoites appear in the salivary glands of the various species, were fairly frequent in the case of *P. falciparum*, but less so with *P. vivax* and *P. inui*. The results are believed to furnish a reasonable indication of the time of development of *P. falciparum* in the above species under natural conditions. The observations in regard to *P. vivax* and *P. inui* were, however, insufficiently numerous to afford reliable evidence. No figures are yet available for *P. malariae*: although 22 batches, each of 10 *A. maculatus*, and 3 batches, each of 10 *A. kochi*, were fed on

cases having quartan gametocytes in the blood, none of the mosquitoes dissected, after an interval of 16 days, showed sporozoites in the salivary glands. Other attempts, using *A. philippinensis* and *A. vagus*, were also negative.

THE RELATIVE SUSCEPTIBILITY OF SOME LOCAL ANOPHELINES TO MALARIAL INFECTION.

There has been a tendency for certain authorities to consider that the harmfulness or otherwise of an anopheline species depends upon its inherent susceptibility to malarial infection. On the other hand, the belief is gaining ground that probably all anophelines are susceptible, and that their relative danger to the community depends only on their numbers and feeding habits. This problem is being investigated under laboratory conditions by Dr. R. Green, using a number of local species. *A. kochi* has been found more susceptible to infection with *P. falciparum*, *P. vivax* and *P. inui* than either *A. maculatus*, *A. vagus* or *A. philippinensis*. This result was unexpected (*A. kochi* appears to be harmless locally) and tends to emphasise the importance of feeding habits as a governing factor in susceptibility under natural conditions.

THE RELATIVE AVIDITY FOR BLOOD OF SOME MALAYAN ANOPHELINES.

In a large series of experiments, various anophelines were given equal opportunity for taking blood from human gametocyte carriers. The age of all the mosquitoes was approximately the same—3 to 5 days—and it is probable that the normal stimulus for taking blood was operative equally throughout the different batches. In addition to the species included in the following table, a few specimens of *A. asiaticus* and *A. watsoni* were applied to human beings, but they refused regularly to take blood:

TABLE XVII.

Species.	No. applied.	No. taking blood.	Percentages taking blood.
<i>A. maculatus</i> ...	2,518	1,838	73%
<i>A. kochi</i> ...	536	249	47%
<i>A. vagus</i> ...	231	106	46%
<i>A. barbirostris</i> ...	40	17	43%
<i>A. philippinensis</i> ...	1,603	621	38%
<i>A. hyrcanus</i> var. <i>sinensis</i>	108	38	35%
<i>A. hyrcanus</i> var. <i>nigerrimus</i>	12	4	—
<i>A. aconitus</i> ...	13	7	—
<i>A. subpictus</i> var. <i>malayensis</i> ...	9	5	—
<i>A. leucosphyrus</i> ...	7	1	—
<i>A. tessclatus</i> ...	6	2	—

A similar series was undertaken in connection with the carriage of *P. inui*, and relative avidity for the blood of *Macaca irus* (*M. cynomolgus*) is shown below:

TABLE XVIII.

Species.	No. applied.	No. taking blood.	Percentage taking blood.
<i>A. maculatus</i> ...	27	24	89%
<i>A. aconitus</i> ...	28	15	54%
<i>A. vagus</i> ...	214	89	42%
<i>A. kochi</i> ...	204	79	39%
<i>A. philippincnsis</i> ...	143	54	38%
<i>A. ludlowi</i> ...	8	4	—
<i>A. subpictus</i> var. <i>malayensis</i> ...	6	4	—
<i>A. separatus</i> ...	2	2	—
<i>Aedes albopictus</i> ...	45	28	62%
<i>Armigeres obturbans</i> ...	45	17	38%
<i>Culex quinquefasciatus</i> ...	100	18	18%

These results furnish an indication of the extent to which the various species of anophelines are likely to feed on human cases and on monkeys, when offered equal opportunity. It is of interest that *A. maculatus*, which is such an important vector of malaria in the hills and foot-hills, shows the greatest avidity for the blood of both human beings and monkeys. Certain species were used in large numbers over eight months of the year, and the percentage taking blood was practically constant from month to month.

EXPERIMENTAL INFECTIONS.

The following anophelines have been infected with *P. falciparum* in the course of laboratory investigations—*A. kochi*, *A. philippincnsis*, *A. vagus*, and *A. aconitus* (mid-gut only). *A. hyrcanus* var. *sincnsis* and *A. subpictus* var. *malayensis* have been infected with *P. vivax*; and *A. kochi*, *A. maculatus* and *A. vagus* (mid-gut only) with *P. inui*.

Up to the present time most of the commoner Malayan anophelines have been infected under laboratory conditions though the following are exceptions: *A. aitkeni*, *A. leucosphyrus*, *A. tessellatus*, *A. asiaticus*, *A. watsoni* and *A. hyrcanus* var. *nigerrimus*. The last species has, however, been found naturally infected during the year. *A. leucosphyrus* and *A. tessellatus* have been found to be capable of biting and taking human blood, and it is intended to attempt the infection of the five species as and when adults are available, though, so far, difficulty has been experienced in inducing *A. asiaticus* and *A. watsoni* to take blood from man.

NATURAL INFECTIONS.

A large number of anopheline mosquitoes taken in the human-bait-mosquito-net trap have been dissected by Mr. E. P. Hodgkin during the year. The results are embodied in the

following table, from which it will be seen that only specimens of *A. maculatus* and *A. hyrcanus v. sinensis* and *v. nigerrimus* were found to be infected:

TABLE XIX.
ANOPHELINE MOSQUITOES EXAMINED FOR MALARIAL PARASITES.

Species.	Totals examined.	Positive.			Remarks.
		Mid-gut.	Salivary glands.	Percentage infection.	
<i>A. aconitus</i>	22	...	...	...
<i>A. barbirostris</i>	97	...	...	...	One specimen with filarial embryos.
<i>A. hyrcanus v. nigerrimus</i>	233	9	5	6.0	
<i>A. hyrcanus v. sinensis</i> ...	231	3	2	2.2	One specimen with filarial embryos.
<i>A. karwari</i>	41	...	...	...
<i>A. kochi</i>	42	...	...	...
<i>A. maculatus</i>	919	34	21	5.9	Four gland infections also had mature oöcysts on the gut.
<i>A. philippinensis</i> ...	46	...	...	...
<i>A. subpictus</i> <i>v. malayensis</i>	2	...	...	...
<i>A. tessellatus</i>	57	...	...	...
<i>A. vagus</i>	43	...	...	...

It should be noted that *A. ludlowi* have not been dissected—trapping has not yet been carried out near tidal waters. And trapping of *A. umbrosus* has not yet been undertaken. The batches of *A. hyrcanus* included a large number of both varieties from the Brickfields Road area, to which reference is made elsewhere. The high infection rates must not therefore be taken as typical of conditions throughout Malaya. With regard to *A. maculatus*, the figures include about 100 specimens from a rubber estate on which no anti-malarial oiling was undertaken. Twenty-eight of this batch were found to be infected. It is therefore probable that the general infection rate for that species would be much lower than the figure shown in the table.

PRECIPITIN REACTIONS.

Precipitin tests have been undertaken on the blood from the stomachs of a number of anophelines caught in the neighbourhood of the abattoir, Kuala Lumpur. The salivary glands of these anophelines have been examined and they have, without exception, been negative for sporozoites.

TABLE XX.
SUMMARY OF PRECIPITIN TESTS ON BLOOD FROM MOSQUITOES TRAPPED NEAR THE ABATTOIR.

Species.	Human only.	Human and Bullock/ Buffalo.	Human, Bullock/ Buffalo and Dog.	Bullock/ Buffalo only.	Bullock/ Buffalo and Cat.	Bullock/ Buffalo and Fowl.	Bullock/ Buffalo and Dog.
<i>A. aconitus</i>	—	...	—	...	—	...	1
<i>A. barbirostris</i>	1	...	—	...	7	...	1
<i>A. hyrcanus v. nigerrimus</i>	—	...	—	...	1	...	2
<i>A. hyrcanus v. sinensis</i>	—	3	1	10	...	...	7
<i>A. kochi</i>	1	...	—	3	...	...	1
<i>A. tessellatus</i>	2	2	1	10	1	1	4
<i>A. vagus</i>	—	...	—	1	...	...	—

MALARIA ON FRASER'S HILL.

Towards the end of the year a few cases of malaria occurred among the labourers employed on this hill station. It was considered desirable to carry out an investigation in order to ensure that infection was not in fact occurring on the hill. For several weeks prior to their illness, none of the four cases had spent a night off the hill, but all had been employed cutting grass during the daytime on an estate in the foot-hills: The labourers left the hill by lorry early in the morning, returning in the afternoon with grass for feeding the dairy herd.

The possibility that infection occurred on the hill appeared very remote: all exposed portions of streams are regularly oiled and no larvae could be found, while all attempts to catch adult anophelines in the lines were unsuccessful. Another possible cause for the cases must be considered. Labourers are examined for malaria when first engaged for employment on the hill. It is well known, however, that malaria may lie latent for long periods. The estate on which they worked in the daytime is at about 500 feet above sea-level, and the labourers descended from a height of about 4,000 feet to that altitude each morning, to return to the hill at night. They were thus subjected to a daily change of atmospheric pressure of about 3" and to a temperature variation of about 20°F. It may be that these changes determined the exacerbation of latent infections.

On the other hand, no anti-malarial work is undertaken on the estate from which grass was being obtained, and *A. maculatus* larvae were found in very large numbers. The estate is worked with Chinese labour, and sixteen individuals were examined. Five had enlarged spleens, but only three were found to be carrying parasites. Ninety-five *A. maculatus* were captured by night trapping, and on dissection, no less than twenty-eight proved to be infected with malaria parasites. To reach more easily this estate from the road, the labourers had cut a narrow path through a belt of jungle about 100 yards wide. Temperature and humidity in this belt during the daytime approximated to the conditions on rubber estates near sea-level at night. Heavy shade shut out all bright light, and it is not improbable that the labourers were attacked by *A. maculatus* while traversing this jungle. Several attempts to trap anophelines during the daytime were made, but only one specimen of *A. aitkeni* was taken. There is thus no direct evidence of the day-light feeding of *A. maculatus*.

IDENTIFICATION OF ADULT MOSQUITOES CAUGHT IN KUALA LUMPUR.

During the first six months of the year the hand catching of anophelines at various stations in Kuala Lumpur was continued by the Health Officer, and the specimens were identified at this

Institute as in the previous year. Hand catching in the stables on the Institute for Medical Research grazing ground was continued throughout the year.

TABLE XXI.
MOSQUITOES CAUGHT IN CATTLE-SHEDS.

Month.	<i>A. aconitus.</i>	<i>A. barbirostris.</i>	<i>A. hyrcanus</i> <i>v. nigerrimus.</i>	<i>A. hyrcanus</i> <i>v. sinensis.</i>	<i>A. karwari.</i>	<i>A. kochi.</i>	<i>A. philippinensis.</i>	<i>A. subpictus</i> <i>v. malayensis.</i>	<i>A. tessellatus.</i>	<i>A. vagus.</i>
<i>Abattoir, Klang Road.</i>										
January	4	72	7	18	...	21	21	...	27	70
February	6	105	8	11	...	9	24	1	11	80
March	5	54	3	...	1	2	16	...	1	215
April ... ..	...	22	2	...	...	...	7	...	...	185
May ... ..	...	72	13	4	4	3	14	...	1	100
June	1	47	12	3	1	9	8	1	13	92
Totals ...	16	372	45	36	6	44	90	2	53	742
<i>Dairy, Rifle Range Road.</i>										
January	12	11	23	51	...	44	46	...	51	22
February	4	2	2	4	...	2	28	8	3	44
March ... ..	...	9	...	...	...	2	16	16	...	94
April	2	7	5	...	...	9	11	9	7	153
May	1	14	14	10	1	25	11	10	17	54
June	1	2	6	9	...	8	9	6	16	54
Totals ...	20	45	50	74	1	90	121	49	94	421
<i>Cattle-shed, Golf Links.</i>										
January	43	16	36	24	1	26	20	17	...	265
February	10	7	3	12	...	2	7	25	...	356
March	3	3	3	1	...	1	2	19	...	406
April	1	7	1	5	...	...	1	3	...	360
May ... ..	...	6	7	11	...	...	...	40	...	523
June ... ..	...	6	3	4	...	2	4	32	...	348
Totals ...	57	45	53	57	1	31	34	136	...	2,258
<i>I. M. R. Stables.</i>										
January	9	2	1	4	...	2	3	4	9	14
February	8	1	1	...	...	...	2	1	...	13
March	5	1	...	...	...	...	4	16	...	32
April ... ..	...	1	2	...	...	...	3	7	1	21
May ... ..	...	1	...	...	...	...	...	3	...	...
June	4	1	...	...	...	...	...	37	1	11
July	12	1	1	1	...	...	3	42	1	6
August	4	1	...	...	...	...	5	27	...	6
September	3	3	1	...	...	...	5	13	...	12
October	8	3	1	2	...	1	4	5	...	7
November	3	8	2	2	...	3	2	1	...	15
December	2	4	...	2	...	4	1	1	2	2
Totals ...	58	27	9	11	...	10	32	157	14	139

TRAPPING IN KUALA LUMPUR.

In the month of September, a human-bait-mosquito-net trap was in operation at the Trade School, Maxwell Road, but only eight anophelines—four *A. barbirostris* and four *A. tesselatus*—were caught. During October the trap was removed to the abattoir, and here also catches were very small. In November the trap was again moved to a squatter's hut quite near the abattoir and a large number of anophelines was taken from then on until the end of the year.

TABLE XXII.

ANOPHELINES CAUGHT BY HUMAN-BAIT TRAP NEAR ABATTOIR.

	November.	December.	Total.
<i>A. aconitus</i>	3	5	8
<i>A. barbirostris</i>	184	157	341
<i>A. hyrcanus v. nigerrimus</i>	21	38	59
<i>A. hyrcanus v. sinensis</i>	55	73	128
<i>A. kochi</i>	170	161	331
<i>A. tesselatus</i>	279	316	595
<i>A. vagus</i>	46	17	63

Larval surveys were made in that area in May, June, October, and November, and it is of interest to compare the adult catches with the results of these surveys:

TABLE XXIII.

SUMMARY OF LARVAL SURVEYS MADE AROUND THE ABATTOIR.

(Number of breeding places found.)

	May.	June.	October.	November.
<i>A. aconitus</i>	2	—	—	—
<i>A. barbirostris</i>	17	13	11	17
<i>A. hyrcanus</i>	3	6	5	11
<i>A. kochi</i>	2	4	—	7
<i>A. philippinensis</i>	—	3	1	1
<i>A. tesselatus</i>	10	2	—	3
<i>A. vagus</i>	1	5	4	3

The differences between the numbers of adults and larvae is not easy of explanation although the achievement of a perfect larval survey is almost impossible. It has been suggested, as an explanation for similar findings elsewhere, that periods of extensive breeding and of high anophelism may not coincide, but it will be necessary to continue the present trapping experiment for at least a year, before any conclusion can be reached.

A NEW METHOD OF MOUNTING MID-GUTS.

The usual methods for mounting infected mid-guts of mosquitoes are slow and uncertain, and a more effective one has been evolved by Dr. R. Green. It gives good and constant results; the pigment of young oöcysts is not obscured in the process, and the time taken from the fixation of a fresh specimen to the production of a stained and mounted preparation is about ten minutes.

The mid-gut is first fixed for a short period in formol-saline and stained with toluidine blue, which appears to have a selective action on young oöcysts. The specimen is then passed through mixtures of acetone and xylol and mounted in Euparal or Canada balsam. Specimens thus stained and mounted have remained unaltered in appearance over a period of 18 months.

THE WASSERMANN REACTION IN MALARIA.

Although many serologists are of the opinion that the occurrence of positive Wassermann reactions in cases of malaria is partly a question of technique and partly of concomitant syphilis, others have reported definitely that positive reactions may be due solely to malarial infection. The general impression at this Institute has been in agreement with the second school, but, during the year, it was decided to undertake a series of Wassermann and Kahn reactions on malaria cases and, if possible, to correlate the findings with the parasite counts. The Harrison Wyler technique has been employed for the Wassermann reactions and the Kahn antigen has been standardised against a batch kindly supplied for the purpose by Dr. Kahn.

The results are of interest. With fifteen benign-tertian cases "one plus", "trace", and "negative" Wassermann reactions were given by 54, 13, and 33 per cent., while the average parasite counts were 5,600, 7,100 and 1,600 per c.mm. respectively. Thirty-seven cases of sub-tertian malaria were also examined and 13 per cent. gave "two plus", 16 per cent. "one plus", 41 per cent. "trace" and 30 per cent. "negative" reactions. The average parasite counts corresponding with these gradations in positivity were 47,000, 28,000, 17,000 and 6,000 per c.mm. Fever *per se* appears to have no influence on either reaction.

Further analysis of the results shows that among the sub-tertian infections, a change from "Wassermann \pm , Kahn—" to "Wassermann++, Kahn++", was noted in one case within a period of 6 days, in three other instances a change from "Wassermann++" to "—" occurred within intervals 7, 11 and 8 days while the corresponding Kahn readings altered from "+", "+", and " \pm " to "-", "-", and " \pm ". Among the benign-tertian cases the Wassermann readings for three cases changed from "+" to "-", from "-" to "+", and from "-" to "+" at intervals of 5, 6, and 15 days; and the corresponding Kahn reading remained unchanged at "—" in the first case, but altered from "-" to "+" in the second, and from "-" to " \pm " in the third.

There appears to be little doubt that non-specific Wassermann and Kahn reactions may occur as the result of malarial infection, and of the two tests, fewer non-specific reactions are given by the Kahn. In the benign-tertian series there were six positive Wassermann and four positive Kahns, and in the sub-tertian series eleven positive Wassermanns but only five positive Kahns. The figures included above indicate that there is some correlation between the degree of positivity and the intensity of malarial infection.

This matter is of importance to those undertaking the treatment of syphilis for among the indigenous population, it is not unusual to find a high parasite count in the absence of fever. When positive serological reports are received on patients who do not present a clear cut clinical picture of syphilis, the examination of blood films prior to the commencement of specific treatment is a desirable precaution.

CULICINES.

In every case where the human-bait-mosquito-net trap has been employed, both anophelines and culicines have been taken. The latter have perhaps been somewhat neglected here of recent years, and no collection exists at the Institute. An assistant has therefore been trained and all culicines captured during the last six months have been identified. The following table shows the numbers of six of the commoner species taken, but specimens of about 20 other species have also been caught in various localities:

TABLE XXIV.
CULICINE MOSQUITOES TAKEN IN TRAP.

Locality.	Period.	<i>Culex fatigans.</i>		<i>Culex gelidus.</i>		<i>Culex vishnui.</i>		<i>Culex tritaeni-orhynchus.</i>		<i>Mansonia uniformis.</i>		<i>Mansonia annuliferus.</i>	
		♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀
Brickfields Road Kuala Lumpur	July	58	180	4	123	2	291	—	58	8	130	1	69
	Augt.	60	332	—	32	1	492	—	17	—	15	—	5
Trade School ...	Sept.	16	125	4	11	5	105	2	9	—	1	—	—
Abattoir, Squatter's hut ...	Nov.	18	78	1	88	—	249	—	63	—	30	—	1
	Dec.	5	17	2	81	1	402	—	58	—	57	—	—
Rubber Estate Estate Lines ...	Nov.	83	721	—	75	—	121	—	14	—	5	—	5
	Dec.	158	1097	—	155	—	165	—	45	—	18	—	5

TROPICAL TYPHUS.

Gauged by the number of positive Weil Felix reactions, the incidence of tropical typhus is steadily increasing within the Federation. For a few years after the first recognition of this disease, a yearly increase in the number of cases was to be anticipated on account of its wider recognition in Government hospitals and in estate practice. But it is doubtful whether this factor has contributed appreciably to the increasing numbers of the past three years. Positive Weil Felix reactions were obtained in 1929, 1930 and 1931 from 155, 175 and 220 individuals respectively. In all the States, with the exception of Perak, the numbers have increased. Nor do these figures indicate the total number of cases, for many of the indigenous population do not seek hospital treatment and estate labourers, with mild symptoms,

are frequently nursed in "group" hospitals from whence specimens may not be submitted for serological examination: thus, cases sometimes escape record.

On analysis, it is found that the numbers agglutinating the Warsaw ("W") strain of *Proteus* X. 19, i.e., cases which usually occur in urban surroundings, are perhaps tending downwards—the figures for 1929, 1930 and 1931 being 48, 51 and 38 respectively. But, on the other hand, cases agglutinating the Kingsbury ("K") strain of *Proteus* X. 19, which usually occur in rural areas, are increasing, the serologically positive cases for 1929, 1930 and 1931 totalling 107, 122, and 182.

Until recently the occurrence, on rubber estates, of cases of the "K" type was very unusual, but there has been a number in the period under review. The explanation of this finding must be sought in the application of new methods of cultivation which have been widely adopted. In order to enrich the soil and also to protect it from erosion consequent upon the heavy rains, nitrogen fixing and other cover crops are employed. These crops form a matted growth, and often attain a depth of some six to eight inches. Thus, in the place of clean-weeding which presented little or no cover for rodents, we now have a method of cultivation which provides excellent protection for rats. Silt-pitting and bunding are also commonly carried out on the older estates as a means to minimise soil wash. These practices are not without their drawbacks: the pits may be two feet in depth and are soon filled with a heavy growth of fern and other plants, thereby providing, in the drier seasons, excellent cover for rodents.

It will be remembered that tropical typhus first came under particular observation as the result of an outbreak on an oil-palm estate where the disease has since been endemic. The rat is a serious pest on such plantations on account of the abundance of food available in the palm fruit. It was pointed out in the last report that the annual kill on this particular estate was about 70,000 rats, and that the catches on other oil-palm areas were on a similar scale. During the last decade, large tracts of land have been alienated for oil-palm cultivation and the probability of the appearance of further endemic areas of tropical typhus has been viewed with concern. A large block of land to the east of Selangor, planted with oil-palms in 1923 and 1924, has been kept under observation in anticipation of an outbreak of the disease. Nineteen cases have now occurred.

There have been no cases on the gutta-percha plantation, mentioned in the last report, since the early months of this year. At the time when infection was occurring, part of the labour was employed in clearing secondary growth, which had come up after felling and burning. The tropical typhus cases occurred among that group of the labour force. No work of a similar nature has been undertaken since the earlier months of the year. It is of interest that rats are few on this plantation. When the cases of tropical typhus were occurring, large numbers of squirrels had invaded the estate from the neighbouring jungle. It may well be that the squirrel also acts as a reservoir of the virus.

PASSAGE TO GUINEA-PIGS ON VITAMIN-DEFICIENT DIET.

During the later months of the year, Dr. R. Lewthwaite and Dr. S. R. Savor have been engaged in an investigation as to the possibility of establishing a strain of tropical typhus in vitamin-deficient guinea-pigs, and the following is their summary of the results that they have so far obtained :—

As previously reported from this Institute, attempts made in the past to infect guinea-pigs with the virus of tropical typhus have met with only ephemeral success. No more than 11 per cent. of several hundreds of guinea-pigs thus inoculated have reacted with fever; and in no case has a passage been maintained beyond the fifth generation. Moreover, as reported last year, the inoculation of guinea-pigs selected from a group known to be susceptible to typhus exanthematicus proved equally unsuccessful.

In the present investigations, the guinea-pigs used have been fed for some days prior to, and subsequent to, inoculation on a diet consisting of water, and auto-claved rolled oats and skimmed milk, this being the diet used successfully by Zinsser, Castenada, and Seastone (Jr.) in their work on the endemic typhus fever of the South-Eastern United States of America.

In three separate instances intra-peritoneal inoculation into vitamin-deficient guinea-pigs of emulsions of brain, spleen, and testicular washings from rats trapped in areas in which human cases of tropical typhus had occurred met with success. After an incubation period of some 5 to 12 days, a marked febrile reaction of 8 to 11 days' duration occurred; in most cases it was much more regular in type than those reactions noted in the few successfully reacting guinea-pigs of previous experiments. In each of the above three instances the passage has been maintained; in one the strain is now in the twelfth generation; in the second, the eighth generation; and in the third, the fifth generation.

Up to the present about one hundred male guinea-pigs have been inoculated in the course of these passages; and of these, 70 per cent. have reacted with marked swelling, redness, and tenderness of the scrotum, these signs becoming evident occasionally on the day prior to the onset of fever, usually coincidently with that event, and, in rare instances, on the second or third day of fever.

These two signs, fever and scrotal swelling, have been induced whether the passage material be brain, spleen, heart blood, or testicular washings. Where testicular washings have been used, alone or in combination with other passage material, the incubation period has been shorter than that induced by other of the above passage material. The extreme virulence of the testicular washings is attested by the fact that on two separate occasions one platinum-loopful of testicular washings, taken at the height of a scrotal reaction, was added to five cubic centimetres of sterile normal saline, two cubic centimetres of

this extremely dilute emulsion were inoculated intra-peritoneally into a vitamin-deficient guinea-pig; and after an incubation period, prolonged in one instance, characteristic febrile and scrotal reaction resulted.

From the fourth passage onward twenty-four guinea-pigs fed on ordinary diet have, at various times, been inoculated intraperitoneally with passage virus. In the majority fever occurred, but was usually irregular; and in only three of the nineteen that were males did scrotal signs appear.

The post-mortem findings have been characteristic, viz., injection of the vessels of the tunica vaginalis, visceral and parietal; haemorrhages on the surface of the tunica vaginalis and in the substance of the polar fat; increase of fluid in the tunica vaginalis; enlargement of the lymphatic glands, frequently accompanied by haemorrhages into their substance; a deposit of fibrin on the surface of the spleen; and, occasionally, sub-pleural haemorrhages and hyperaemia of the supra-renal glands. Examination of Giemsa-stained smears of both fibrin from the surface of the spleen and of fluid from the tunica vaginalis has revealed within endothelial cells large numbers of short bipolar-staining organisms. These closely resemble those observed by Mooser, Maxcy, and Pinkerton in tunica and spleen smears of guinea-pigs infected with the virus of Mexican and European typhus and also those observed by Anigstein in similar material from rats and guinea-pigs infected with tropical typhus virus.

Further evidence of the typhus-like nature of the above infections has been afforded by the Weil-Felix reaction in rabbits. At various stages during the series of passages, virus from the guinea-pigs of two of the three strains has been inoculated intraperitoneally into thirty rabbits. Of these, eighteen gave inconclusive or negative results, but twelve gave agglutination titres ("O" type) varying from 1/125 to 1/825. Both the "K" and "W" strains of *Proteus* X. 19 were used. In the case of one of the guinea-pig strains the significant agglutination was in each case (6) only of the "K" strain. In the case of the other guinea-pig strain, the significant agglutination was, in four instances, of the "W" strain; and in two further instances, both rabbits having been inoculated at the same time with the same passage virus, the resulting agglutination was of the "K" strain in the one, and of the "W" strain in the other. In each case the blood was drawn from the rabbit before inoculation, and subsequent to inoculation on the 10th, 15th, 20th, 25th, 30th, and 35th days; and the typical waxing and waning titre, with the fastigium reached between the 15th and 25th days, was obtained in all twelve cases. The proportion of reacting rabbits, and the height of the titres attained, far exceed those previously obtained by intra-peritoneal inoculation into rabbits of blood drawn at the height of fever from human cases of tropical typhus.

Throughout these experiments, inter-current infection of the guinea-pigs has been a constant source of anxiety. Of some 200 vitamin-deficient male and female guinea-pigs, two have

succumbed to infections with *B. paratyphosus B.*, and nine with *B. enteritidis*, Gaertner. At the commencement of the investigation, a guinea-pig, inoculated with material from a local rat, developed an apparently typical scrotal swelling; intra-peritoneal injection of testicular washings into another guinea-pig was followed, after a very short interval (24 to 48 hours), by a similar reaction. It was found, however, that the cause in this instance was *B. whitmori*, doubtless from a latent infection in the original rat. The scrotal swelling was, in fact, a Strauss' reaction; which is obtainable with *B. whitmori*.

THE INTRA-OCULAR INJECTION OF VIRUS.

Towards the end of the year Dr. R. Lewthwaite and Dr. S. R. Savor commencing a study of the virus of tropical typhus maintained by intra-ocular passage in the rabbit; prompted by the successful demonstration of the viruses of the tsutsugamushi disease and typhus exanthematicus by this method in the hands of Nagayo, Tamiya, and their collaborators, and published by them earlier in the year. The following is their summary of the early results obtained:—The technique of the Japanese workers was followed closely, viz., the withdrawal of 0.1-0.2 c.cm. of aqueous humour prior to inoculation of a similar quantity of virus. The virus used was, in all cases but one, blood that had been drawn from the patient as early as possible in the course of the disease (usually between the fourth and the eighth day) and defibrinated; in the one exception it consisted of testicular washings from a guinea-pig infected with tropical typhus, and exhibiting the characteristic scrotal swelling. In two or three instances passage of the virus could not be maintained, since occasional rabbits proved refractory to inoculation.

But in two instances passage has been successfully maintained. In the first of these instances, initial inoculation of the blood, drawn from a human case on the sixth day of fever, has led to the establishment of a strain that is now in its thirteenth passage; in the second instance, initial inoculation of testicular washings has resulted in the establishment of a strain that is now in its seventh passage.

The signs that mark reaction to the intra-ocular inoculation of tropical typhus virus closely resemble those noted by Nagayo and his colleagues. Within twenty-four hours of inoculation of infected blood there occurs a non-specific reaction—a degree of circum-corneal injection and injection of the iris—which subsides usually in three to four days. Where the inoculum is passage virus, i.e., infected anterior chamber fluid, this immediate reaction is either very slight or even entirely absent; as yet it has never exceeded 48 hours in duration. An incubation period follows that persists usually from six to eight days, but not infrequently has wider limits. The signs of the true reaction, which is an acute iritis are, in order of occurrence, circumcorneal injection, progressive injection of the vessels of the iris,

progressive turbidity of the aqueous humour, and, in a minority of rabbits, the appearance of an exudate. In most cases intraocular tension is manifestly increased. The fastigium of the iritis is reached in the majority of cases about the fourth to the eighth day of the evolution of signs; after which the condition gradually subsides, cloudiness of the aqueous humour being the last sign to disappear. Those rabbits—some twenty in number—whose temperatures have been recorded daily have shewn no febrile reaction during the evolution of the iritis.

Scrapings of the endothelium lining Descemet's membrane, made at the height of the reaction, and stained by Giemsa's method, reveal a picture that again corresponds closely with that found by Nagayo and his colleagues in similar scrapings during the iritis induced by the virus of typhus exanthematicus, namely, clusters within the endothelial cells of short rod-shaped bipolar-staining bacilli, found in greatest concentration close to the nucleus. Occasionally they completely fill the cell and, in some cases, lie scattered without the ruptured cell margin, giving the impression that by reason of prolific multiplication within the cytoplasm they have caused ultimate rupture of the cell. In a few instances chain forms have been noted, which adequate differentiation during staining reveals as chains of the above bipolar-staining bacilli. In morphological and staining characteristics they closely resemble those diplo-coccal micro-organisms isolated by Anigstein in culture from human and passage virus of tropical typhus; and also demonstrated by him in smears from the tunica vaginalis of guinea-pigs successfully infected with the virus of this disease by the intra-peritoneal route.

THE RESULTS OF PROPHYLACTIC VACCINATION.

A brief note on the preliminary results obtained with a vaccine prepared by Dr. L. Anigstein, from organisms isolated from rats, was included in the last report. The vaccine was prepared in two strengths, namely, of 200 and 400 million organisms per c.cm., and two injections were given at an interval of seven days, the dosage being 100 million and 400 million. The labour force in this endemic area totalled nearly 700 individuals, of whom 300 received two doses, and 70 the first inoculation only. Vaccination was undertaken towards the end of July, 1930, and there was an encouraging decrease in incidence of tropical typhus in the remaining months of the year.

It has been possible to analyse the cases which have occurred since that time. In the six months following vaccination there were 16 cases of tropical typhus of which four had been vaccinated, nine had not been vaccinated, and three were not on the estate at the time of vaccination, or whether or no they had been vaccinated is unknown. During the next six months, however, 14 cases occurred, of which 11 had and two had not been vaccinated. In the last five months of this year there have

been 17 cases, of which four had and three had not been vaccinated. Since the date of attempted protection, some 17 months ago, there have thus been 48 cases, of which 19 belonged to the vaccinated and 14 to the unvaccinated groups.

The conclusion is therefore justified that the vaccine may perhaps have prophylactic value, but that any consequent immunity is of a fleeting order and no protection whatever is afforded after an interval of six months.

Certain statistics are also available regarding the possible effect of vaccination on the case mortality of the disease. During the present year, among a known total of 15 cases in vaccinated persons, there have been six deaths—a case mortality of 40 per cent. Among the unvaccinated groups there have been five known cases, with two deaths—a case mortality also of 40 per cent. It is not possible to draw conclusions from these small figures, but there is a suggestion that case mortality was unaffected by the vaccination. Explanation of this high case mortality is necessary: only the more serious cases were evacuated from the estate to Government hospitals and thus came under observation. The actual case mortality from tropical typhus throughout the country does not exceed about 12 per cent.

THE WEIL-FELIX REACTION.

At the suggestion of Dr. W. Fletcher suspensions of living cultures have been introduced into the routine Weil-Felix reactions and an analysis of the results obtained with alcoholized and living emulsions has been made by Dr. P. H. Martin. The stock *Proteus* X. 19 “K” and “W” strains were daily sub-cultured on dry agar, but a permanently non-spreading strain was not obtained. On the other hand, partial success in the production of an “O” cultures of non-motile bacilli and non-spreading colonies had been achieved by Dr. Sen working in Singapore, and cultures were supplied to this Institute by the courtesy of Professor W. A. Young. Those “K” and “W” strains have been employed as living emulsions for routine tests, in addition to the usual alcoholized suspensions. They have been sub-cultured at room temperature, almost daily, on agar slopes previously dried for at least three days in an incubator at 46°C.

Later in the year, Dr. Felix kindly forwarded his non-motile, non-spreading strains “OXK”, “OX2” and “OX19”. The two latter did not appear to be superior to the “W” strains already in use, and they have not been employed in routine tests. But the “OXK” strain gave results which were easy to read: the agglutinated masses were coarser and the clearing better than with the Singapore or the Institute for Medical Research “K” living cultures. It was therefore introduced into the routine tests. The culture of this strain (“OXK”), which had been put into stock, was later found to have developed motile and spreading forms, but the isolation of non-spreading and non-motile smooth cultures was possible by re-plating.

The Alcoholized and Living Suspensions.

The alcoholized suspension of *Proteus* X. 19 "K" for the routine tests is prepared from a spreading motile culture which has been employed for the purpose for the past three years. This suspension will be referred to as A.S. "K" No. 1. Towards the end of the year, a second alcoholized suspension, A.S. "K" No. 2, was prepared from a culture which, for several months, had been sub-cultured daily on dry agar slopes at room temperature. Except for a very short interval, non-motile and non-spreading forms had not occurred. There was no appreciable difference in sensitivity between the suspensions A.S. "K" No. 1 and A.S. "K" No. 2. A further batch, A.S. "K" No. 3, was prepared from a non-spreading colony of the Singapore strain, and was found to be considerably more sensitive than batches A.S. "K" No. 1 or A.S. "K" No. 2. In December the "OXK" strain received from Dr. Felix was found to be motile and spreading: in the cultures undergoing daily sub-culture on dried agar and in stock strains, sub-cultured monthly, spreading colonies were found. After this partial reversion to the motile spreading form, an alcoholized suspension of "OXK" (then in part "HXK") was prepared for the routine tests. This suspension will be referred to as A.S. "OXK".

Living emulsions of *Proteus* X. 19 "K" were also used. An emulsion of the strain received from Singapore ("K" Living No. 1) was prepared daily from colonies selected having due regard to the maintenance of smoothness and lack of spreading properties. A second suspension, Living OXK, from the strain "OXK" received from Professor Felix has also been in use. It has been sub-cultured daily on dry agar slopes, and, except for a short period, the culture has been non-motile and non-spreading.

An alcoholized suspension of a *Proteus* X. 19 "O" (Institute for Medical Research "W") culture, which has long since reverted to the spreading form, has been employed for routine diagnosis in the past three years. This suspension will be referred to as A.S. "W". A "W" strain was also supplied by Dr. Sen at the same time as he forwarded his "K" strain. It has been sub-cultured almost daily on dry agar slopes, but on no occasion has a non-spreading colony been found which, following inoculation into peptone water, has shown no motile forms. Living emulsions of this strain have been employed in routine tests during the latter part of the year, and the suspension will be referred to as "W" living.

This analysis is confined to results obtained from routine tests carried out with these suspensions against sera from suspected enteric and tropical typhus cases. Since the introduction of the living cultures, specimens showing an agglutination titre of 1/100 or over have been tested from just over a hundred cases in which the clinical picture justified a diagnosis of tropical typhus. The series may be divided up for purposes of comparison into periods "A", "B", "C", "D" and "E" according to the various suspensions employed. During the periods "A" and

"B", the Singapore "K" culture ("K" Living No. 1) was becoming more nearly non-motile and less spreading. This development continued during period "C", but, in this interval, trouble was experienced by the appearance of a small proportion of atypical rough colonies. Sub-cultures were continued from smooth colonies only. The period "D" starts with the introduction in routine tests of culture "OXK" (Living OXK) and "E", with the addition of A.S. "K" No. 3. Thus in the periods "A", "B" and "C" each serum was tested against living and alcoholized "K" and "W" suspensions. During periods "D" and "E" each serum was, in addition, tested with *Proteus* "OXK", living. The alcoholized suspension of "OXK" (in part HXK)—A.S. "OXK" was introduced in period "D".

The technique employed was that of Dreyer. Tests with alcoholized suspensions were kept in a water bath at between 48° and 52°C., while the living emulsions were placed in a bath at 37°C. The living emulsions remained in the water bath for two hours, when initial readings were made, and afterwards were exposed to room temperature until the final readings on the following morning. The alcoholized suspensions were first read after two to three hours at about 52°C. and the tubes were then returned to the water bath until re-reading on the following morning. No tube was reported as negative until after 20-24 hours' incubation, and the final titres of tests were not determined until after a similar interval of time. All titres are reduced to "Standard Agglutination" by the use of Dreyer's Reduction Table. Normal saline controls were put up with each batch of tests, and control tests with 3.6 per cent. saline (NaCl) were put up daily against living cultures and weekly against alcoholized suspensions. Immune rabbit serum controls were used at weekly intervals with the living emulsions, and, less frequently, with the alcoholized suspensions.

Relative Sensitivity of Living and Alcoholized Emulsions.

During the periods "A", "B", and "C", emulsions "K" Living No. 1 appeared gradually to become more sensitive in relation to A.S. "K" Nos. 1 and 2. At first, titres only slightly above those with the alcoholized suspensions were obtained, but later, increasing sensitivity developed until the readings were about twice as high as those with the alcoholized suspensions. This finding was not occasioned by deterioration in the sensitivity of the alcoholized suspensions. With the latter the titre of immune serum from rabbit No. 48 (immunised with the Singapore "K" culture, and not completely devoid of "H" agglutinins) remained constant at 1/2,800. With the commencement of period "E" and the introduction of A.S. "K" No. 3, the titres with human sera became about equal to those obtained with the living emulsions, and immune serum from rabbit No. 48 showed a rise in titre to 1/5,100. Thus, from the fall in relative sensitivity of living culture and the rise in titre of the immune serum it was evident that the sensitivity of suspension A.S. "K" No. 3 was about twice that of previous batches.

The findings for all positive "K" human sera and for controls with immune serum (Rabbit No. 48) are summarised in the following table, in which the average titres with living emulsions are compared with the average titres with alcoholized emulsions, the latter being taken as unity. Sera giving titres of 1/5,000 or over have been excluded because routine tests are carried out to that maximum only. It must be understood that the figures for relative sensitivity are averages only of the readings of the Weil-Felix reactions undertaken during the periods. In individual instances departures from the usual ratio were noted.

TABLE XXV.
SENSITIVITIES OF "K" LIVING No. 1 EMULSIONS REFERRED TO THOSE OF THE ALCOHOLIZED SUSPENSIONS AS UNITY.
(The figure in brackets indicate the number of tests of which the titre is the average.)

Period.	Numbers		Average titres with <i>Proteus X. 19</i> "K".			Average titres with "K" immune serum (Rabbit No. 48).	
	of cases.	of Weil-Felix reactions.	Batch No. (alcoholized).	Alcoholized.	Living culture "K" No. 1 (Singapore).	Alcoholized "K".	Living culture "K" No. 1 (Singapore).
A	17	30	A.S. 1	1.0	1.08		
B	20	33	A.S. 1	1.0	1.5		
C	34	46	A.S. 1	1.0	1.9	1/2800 (2)	1/4600 (18)
D	24	32	A.S. 1 & 2	1.0	2.6	1/2800 (8)	1/4200 (11)
	8	10	A.S. 3	1.0	0.94	1/5100 (3)	1/4500 (3)

TABLE XXVI.
SENSITIVITIES REFERRED TO THAT OF LIVING "ONK" EMULSION AS UNITY.

Period.	Numbers		Average titres of <i>Proteus X. 19</i> "K".					Average titres with "K" immune serum (Rabbit No. 48).				
	of cases.	of Weil-Felix reactions.	Alcoholized suspensions.			Living emulsions.		Alcoholized suspensions.			Living emulsions.	
			A. S. Nos. 1 and 2.	A. S. No. 3.	A.S. "ONK".	No. 1 (Singapore).	No. 2 ("ONK").	A. S. Nos. 1 and 2.	A. S. No. 3.	A.S. "ONK".	No. 1 (Singapore).	No. 2 ("ONK").
D	24	32	0.3	...	0.73	0.56	1.0	(8) 1/2800	...	(8) 1/4400	(11) 1/4200	(10) 1/4800
E	8	10	...	0.9	0.68	0.9	1.0	...	(3) 1/5100	(3) 1/4600	(3) 1/4500	(3) 1/4800

In the above table (No. XXVI) the same cases are included as those in periods "D" and "E" of table No. XXV but duplicate living and alcoholized suspensions of "OXK" were employed, and the sensitivity of the suspensions is expressed in relation to the titres with living "OXK". The figures show that there was a marked gain in sensitivity of the alcoholized emulsion of the "K" strain on the introduction of batch A.S. "K" No. 3. The replating and selection of a colony for that alcoholised suspension followed the introduction of sub-cultures from the same colony for the "K" Living No. 1 emulsions. This change is reflected in the human Weil-Felix figure, but not in the case of rabbit immune serum. In the figures relating to A.S. "OXK" the slight difference in readings is explicable by experimental error.

Prior to this investigation, each batch of alcoholized emulsion for routine tests was tested against known positive human sera, but no correction factor for standardisation was employed. Whether in actual fact there has been much variation in sensitivity between batches it is unfortunately impossible to say; but there can be no doubt that the later alcoholized emulsion of the Singapore "K" strain (A.S. No. 3) is decidedly more sensitive than the batches previously in use. It is suggested that readings obtained with Felix's "OXK" culture using his technique of incubation for two hours at 37°C. and a further period at room temperature over-night, might well be adopted as a standard. By reporting titres as nearly as possible equal to those obtained by that method, results would be more nearly uniform over long periods of time. We should also have a basis for the comparison of results obtained by workers in other parts of the world. According to the suggested standard, it is probable that "K" titres for the Weil-Felix reaction reported from this Institute since 1929, have been too low by 50 per cent.

No particular investigation of agglutinable suspensions for the "W" type have been made during the year, but the results of routine tests appear to have been satisfactory. A relatively few positive sera have been tested in duplicate with alcoholized and living suspensions, and no marked inferiority in sensitivity of the former has been noted. In fact, on occasions the alcoholized suspensions seem to have been more sensitive than the living cultures grown on dry agar and of very similar sensitivity to the living "OX19" cultures supplied by Dr. Felix.

Cases Demonstrating the Value of Living Emulsions.

In a number of cases which gave a higher titre with living emulsion than with alcoholized suspension a final diagnosis of tropical typhus was made either on clinical grounds or by an increase in titre of later specimens.

TABLE XXVII.
TROPICAL TYPHUS CASES WITH LOW ALCOHOLIZED
SUSPENSION TITRES.
[Cases are divided into two groups. In the second group (A.S.
titres 1/100 to 1/200) the utility of living emulsions
has been most marked.]

Where original titre with alcoholized "K" suspension was under 1/100.				Where original titre with alcoholized "K" suspension was over 1/100 but under 1/200.			
No.	Day of illness.	"K" titres.		No.	Day of illness.	"K" titres.	
		(Alc.)	(Living.)			(Alc.)	(Living.)
753	15th	1/28	...	760	...	1/170	1/440
	26th	1/30	1/110	773	23rd	1/170	1/220
786	13th	1/70	1/70	827	9th	1/110	1/500
	23rd	1/140	1/170	841	11th	1/160	1/600
836	9th	1/96	1/220		19th	1/125	1/220
	23rd	1/70	1/125	896	32nd	1/160	1/380
850	22nd	1/34	1/110	978	13th	1/170	1/340
875	8th	1/30	1/50		21st	1/190	1/340
	14th	1/125	1/280	1093	15th	1/125	1/440
	19th	1/85	1/190		22nd	1/65	1/75
915	10th	1/56	1/300	1095	...	1/190	1/500
	18th	1/96	1/340	1096	17th	1/170	1/340
	23rd	1/140	1/380	1105	12th	1/110	1/190
956	...	1/96	1/300		19th	1/110	1/140C
1004	36th	1/85	1/250	1106	11th	1/125	1/770
1030	38th	1/96	1/150				
1038	16th	1/85	1/280				
	23rd	1/140	1/380				
1062	11th	1/56	1/140				
	18th	1/280	1/880				
1070	16th	1/34	1/190				
	23rd	1/125	1/280				
1107	14th	1/56	1/140				
	26th	1/440	1/770				

The day of disease given in the above table must be regarded as approximate only. The date of onset is given by the patient, whose ideas are frequently vague, and these data are therefore subject to a wide margin of error. All the above instances are confirmatory of Felix's statement that cases of tropical typhus may be missed by the non-inclusion of living emulsions in the Weil-Felix reaction.

Results with Sera from Non-Typhus Cases.

An analysis of results during the periods "D" and "E" shows that with 69 specimens of serum from 52 patients, presumably febrile when blood was drawn, the Weil-Felix titre on one or more occasions was very low or doubtful. Clinically, however, the fever was not attributable to tropical typhus or enteric fever. Analysis of the titres from these cases (expressed in terms of standard agglutination) is as follows:

Titre.	Alcoholized suspensions.				Living suspensions.			
	"K" No. 3.		"OXK."		"K" No. 1.		No. 2.	
	(S'pore.)				(S'pore.)		"OXK."	
0 to 1/49	...	66	...	67	...	46	...	56
1/50 to 1/74	...	2	...	2	...	17	...	5
1/75 to 1/99	...	1	...	0	...	4	...	5
100 +	...	0	...	0	...	2	...	3

The Weil-Felix Reaction in Enteric Fevers.

During the same periods, the Weil-Felix reaction was undertaken on 16 cases which proved to be enteric fever, and an analysis of the "K" and "OXK" titres from 21 specimens taken from these cases are given below :

Titre.	Alcoholized suspensions.				Living suspensions.			
	"K" No. 3.		"OXK."		"K" No. 1.		No. 2.	
	(S'pore.)				(S'pore.)		"OXK."	
0 to 1/49	...	15	...	15	...	9	...	14
1/50 to 1/99	...	3	...	3	...	9	...	4
1/100 +	...	3	...	3	...	3	...	3

Particulars concerning the three cases with "K" titres exceeding 1/100 and of a case of *paratyphoid A*, observed earlier in the year, are as follows:

Case No. 1: A male Chinese, aged 40. *B. typhosus* was isolated from the specimen of blood submitted on the eleventh day of illness, for the Widal and Weil-Felix reactions. Death occurred on the fourteenth day, and autopsy revealed congestion and oedema of the lungs, dilated right heart, and early ulceration of Peyer's patches. There were areas of congestion along the small and the upper part of the large intestine, and the spleen (no malarial pigmentation) was enlarged to about three times the normal size. Absorption tests with living cultures of *B. typhosus* and *B. proteus* "OXK" were performed, and no cross absorption of agglutinins occurred. The differences in reduced titres for typhosus "O" agglutinins is probably explicable by experimental error:

	Typhosus.		"H" Paratyphosus.			Weil-Felix.			
						"K" (S'pore).		"OXK."	
	"O."	"H."	"A."	"B."	"C."	(Alc.)	(Liv.)	(Alc.)	(Liv.)
Unabsorbed	R.T. 28	1/3500	0	1/44	1/44	1/140	1/270	1/170	1/150
Absorbed <i>B. typhosus</i>	0	1/200	...	1/34	1/34	1/120	1/210	1/140	1/140
Absorbed <i>Proteus</i> "OXK"	56	1/3500	...	1/44	1/44	0	0	0	0

Case No. 2: A male Tamil, aged 25. Agglutination tests were undertaken on the ninth, fourteenth, and twenty-fourth days of disease with the following results:

Day of disease.	Widal typhosus.		Weil-Felix.					
			"K" (S'pore).			"OXK."		
	"O."	"H."	(Alc.)	(Living.)		(Alc.)	(Living.)	
	R.T.							
9th	17	1/440	1/96	1/64	1/190	1/110		
14th	21	1/500	1/140	1/110	1/190	1/125		
24th	16	1/110	1/50	1/170	1/110	1/150		

Case No. 3: A male Chinese, aged 40, was admitted to hospital on the tenth day of illness with a history of fever, headache and loss of appetite. Rose-coloured spots were present on the trunk. Fever was low but continued, and gradually reached normal on the twentieth day. On the thirty-fourth day, however, there was a sudden relapse with remittent fever for 14 days and *B. typhosus* was isolated from the specimen of blood submitted on the thirty-fifth day for the Widal reaction. The patient was discharged from hospital on the sixtieth day of illness, i.e., on the thirteenth day after he had last become afebrile. Agglutination titres are shown below, and, except where specially indicated, all were of the "O" type. The living emulsion of the "W" strain was from the Singapore culture corresponding with "K" strain used for living emulsions, it has never been obtained in true "O" form and its sensitivity for "O" agglutinins appears to be very similar to that of *Proteus* OX19 of Felix.

Day of disease.	Widal		Weil-Felix.					
	<i>B. typhosus</i> .		"K" (S'pore).		"OXK."		"W" (S'pore).	
	"O."	"H."	(Alc.)	(Liv.)	(Alc.)	(Liv.)	(Living.)	
	R.T.							
17th	37 ... 1/125 ... 1/125 ... 1/340 ... 1/125 ... 1/110 ... (1/770 "H")							
28th	Temperature had been about normal for seven days.							
28th	17 ... 1/34 No reading 1/680 ... 1/220 ... 1/880 ... (1/770 "H")							
34th	Relapse started.							
35th	<i>B. typhosus</i> isolated from blood for Widal.							
35th	19 ... 1/380 ... 1/32 ... 1/340 ... 1/50 ... 1/440 ... (1/340 "H")							
60th	Patient discharged from hospital.							

There is no direct evidence as to the cause of the positive Weil-Felix reaction, though it may be that the agglutinins, both "H" and "O", were residual from a previous infection.

Case No. 4: Early in the year, before the "OXK" culture was available, the case of a male Tamil, aged 27 years, was investigated. He had been admitted to hospital in April, 1930, when where a clinical diagnosis of paratyphoid fever was made. The temperature chart was more compatible with a mild enteric infection than with tropical typhus. The Widal and Weil-Felix results, obtained when he was in hospital in April, 1930, are given below:

Day of illness.	Typhosus.				"H" Paratyphosus.					Weil-Felix.				
	"O."		"H."		"A."		"B."		"C."		"K" (Alc.)		"W" (Alc.)	
	R.T.													
17th	...	—	...	0	...	0	...	0	...	0	...	1/125	...	0
25th	...	—	...	0	...	0	...	1/125	...	0	...	1/125	...	—
32nd	...	—	...	0	...	0	...	1/250	...	1/25	...	0	...	—

In August, 1931, he was re-admitted, and a provisional clinical diagnosis made of influenzal pneumonia. From specimens of faeces and urine collected on the twenty-ninth day, *B. paratyphosus* A was isolated. The patient recovered. He was a fairly well-educated man and definitely denied previous anti-enteric vaccination. The "K" Weil-Felix readings for this

case are only about one-half the titres which would have been obtained with a living suspension of the "OXK" strain. The following are the results after his re-admission to hospital:

Day of illness.			Typhosus.		"H" Paratyphoid.			Weil-Felix.		
			"O."	"H."	"A."	"B."	"C."	"K."		"W" (Alc.)
								(Alc.)	(Living.)	
7th	...	...	R.T. 0	1/280	1/1000	1/380	1/280	1/25	1/34	1/22
13th	..	...	0	1/500	1/880	1/250	1/250	1/110	1/125	1/22

Suspiciously High Titres with Sera from Other Cases.

Fairly high titres with living emulsions were sometimes given by sera from patients suffering from beri-beri, influenza, diabetes, pneumonia, etc. Particulars of such cases are given below, and in all instances great care has been taken to exclude a possible diagnosis of tropical typhus.

TABLE XXVIII.
NON-TYPHUS CASES AGGLUTINATING LIVING EMULSIONS.

No.	Day of illness.	Weil-Felix.						Clinical diagnosis.
		"K."		"OXK."		"W."		
		(Alc.)	(Living.)	(Alc.)	(Living.)	(Alc.)	(Living.)	
13	15th	0	0	0	1/96	...	...	Beri-beri
	23rd	0	1/110	0	0	...	...
	28th	0	1/110	0	0	...	...
16	11th	0	1/75	0	1/75	...	...	Influenza
	19th	0	1/50	0	1/50	...	...
24	9th	0	1/64	0	0	...	...	Influenza
	13th	1/96	1/50	0	1/50	...	...
	16th	0	1/56	0	0	...	...
27	...	0	1/220	1/50	1/110	...	...	Healthy contact of a "W" case of T. Typhus
748	11th	0	...	...	...	...	...	P. U. O. "L"
	20th	1/110	1/125	...	...	...	...
	26th	1/56	1/150	...	...	...	...
967	13th	1/75	1/110	...	...	...	...	Pleurisy with effusion
968	9th	0	0	...	...	...	...	P. U. O. plus Ankylostomiasis
	15th	0	1/85	...	...	...	...
982	9th	0	1/110	...	...	...	...	Diabetes and Pleurisy with effusion
	16th	1/50	0	...	...	...	...
	23th	0	1/50	...	...	...	...
1090	16th	0	1/170	...	...	...	...
	20th	0	0	...	...	...	...	P. U. O. "L"
1089	9th	0	0	...	...	...	...	Bronchopneumonia died on 20th day
	18th	0	1/85	...	...	...	...
1112	5th	0	0	...	...	...	...	Pleurisy with effusion (probably tuberculous)
	10th	0	1/160	...	1/115	...	...
	16th	0	1/56	...	1/50	...	...
1124	11th	0	1/96	0	0	...	...	P. U. O. "L"
	14th	1/50	1/85	0	0	...	...
	21st	0	1/50	0	1/110	...	...
1133	10th	0	0	0	0	...	...	Influenza
	16th	0	1/85	1/50	1/170	...	...
	22nd	0	1/125	1/56	1/50	...	...
1142	10th	0	1/140	0	0	1/96	1/140	P. U. O. "L"
	18th	0	1/125	1/85	0	1/110	1/125	
955	7th	1/96	1/85	...	...	...	...	Landed from Europe in F.M.S. two days before onset of an illness
922	...	1/50	1/110	...	...	...	...	Healthy contact of T. Typhus case
		1/110	1/96	...	...	...	...

In the above table, "O" refers to titres of less than 1/50. The cases marked "L" were seen by Dr. R. Lewthwaite, who considered that in none was a diagnosis of tropical typhus tenable. For comparison, the following figures are given relative to five

cases which, although the Weil-Felix reaction gave negative or low results, a diagnosis of tropical typhus was confidently made on clinical grounds.

No.	Day of illness.	"K."		"W."		
		(Alc.)	(Living.)	(Alc.)	(Living.)	
847 ...	10th ...	0	0	0	1/96	Died on 15th day
753 ...	15th ...	0	—	0	—	
	26th ...	0	1/110	0	—	Discharged on 25th
1,030 ...	36th ...	1/96	1/150	0	0	
786 ...	13th ...	1/70	1/70	0	0	
	23rd ...	1/140	1/170	0	0	
836 ...	10th ...	1/96	1/220	0	0	
	24th ...	1/70	1/190	0	0	

The Weil-Felix Reaction in Japanese River Fever.

Six cases of Japanese river fever, all Europeans, have been observed during the year. One (No. 612) proved fatal. The first case (No. 606) was a woman, the rest were men. From case No. 630, which was probably infected while in company with case No. 612, the ulcer was excised on the fifth day when his temperature was known to have been raised for 48 hours. The course of his disease was mild. The following table includes the Widal and Weil-Felix findings for these cases:

TABLE XXIX.

No.	Day of illness.	Widal readings.					Weil-Felix readings.			
		Typhosus.		"H" Paratyphosus.			"K."		"W."	
		"O."	"H."	"A."	"B."	"C."	(Alc.)	(Living.)	(Alc.)	(Living.)
606	7th	R.T. 3	0	0	0	0	1/85	...	0	...
	11th	0	1/140	1/25	0	1/44	1/680	...	0	...
612	7th	0	1/320	0	0	1/25	1/25	...	1/25	...
	10th	0	1/440	0	0	0	0	...	0	...
630	5th	4	1/1,130	1/1,130	1/125	1/50	1/25	...	0	...
	10th	6	1/1,500	1/1,500	1/140	1/2,200	1/85	...	0	...
771	14th	0	0	0	0	0	1/170	...	0	...
	19th	0	0	0	0	0	1/2,200	1/2,200	0	0
778	8th	0	0	0	0	0	0	0	0	0
	13th	0	1/56	1/50	0	0	1/125	1/140	0	0
1007	17th	0	1/22	1/28	0	0	1/75	1/250	1/25	0
	8th	13	1/770	1/2,800	1/140	1/96	1/56	1/250	0	0
	10th	14	1/5,600	>1/7,000	1/220	1/380	1/65	1/340	0	0
	17th	14	1/5,000	>1/7,000	1/770	1/700	1/2,200	1/5,000	0	0
	23rd	21	1/2,200	1/28,000	1/770	1/700	>1/5,000	>1/7,000	0	0
	47th	7	1/192	1/4,400	1/440	1/440	1/770	1/3,500	0	0

With regard to case No. 1,007, despite the high *B. typhosus* "O" R.T. titres which are suggestive of the carrier state, no organisms of the enteric group could be isolated from several specimens of faeces and urine. He had been vaccinated against typhoid fever three years previously, but no history of enteric infection could be obtained. Four of these six cases of Japanese river fever thus developed a definitely positive Weil-Felix reaction. In one negative instance, a fatal case, a specimen of blood could not be obtained after the eleventh day. In the second, the latest day of the disease on which blood could be obtained was the tenth day and then the "K" alcoholized emulsion was agglutinated to a titre of 1/85. From the more recent investigations of the sensitivity of that suspension, it appears probable that a titre of at least 1/150 would have been obtained with a living culture of "OXK".

The Weil-Felix Reaction in Leptospirosis.

A diagnosis of leptospirosis on a male European case, aged 27, was made clinically and later confirmed by the results of guinea-pig inoculation (blood). On the sixth, eleventh and thirteenth days of illness, specimens of blood were obtained. The Widal was negative throughout as was also the reaction with "OX19" ("W"); but the alcoholized suspension of the "K" strain ("OXK") was agglutinated to titres of 1/25, 1/220, and 1/220, respectively. There was no history of a previous attack of tropical typhus.

A Case of Tropical Typhus agglutinating both "K" and "W" Strains.

A case of tropical typhus observed during the year in a female Tamil, aged 22, is of considerable interest because both "OXK" and "OX19" ("K" and "W" strains) were agglutinated simultaneously to high titres. On account of the rise in "K" and the fall in "W" agglutinins during the course of the disease, the case was considered to be of the "K" or rural type. Further, she had been employed for 11 months prior to admission to hospital on an oil-palm estate which is a persistent source of "K" cases and on which only one "W" case is known to have occurred. The patient recovered.

TABLE XXX.
WEIL-FELIX READINGS.

Day of illness.	"OXK."		"W."		"OX19."	"OX2."
	(Alc.)	(Living.)	(Alc.)	(Living.)	(Living.)	(Living.)
11th ...	1/340	1/1,000	1/1,130	1/1,900	1/800	1/34
14th ...	1/330	1/770	1/880	1/680	—	—
21st ...	1/2,200	1/1,900	1/250	1/110	—	—
28th ...	>1/5,000	1/5,000	1/190	1/190	—	—
31st ...	1/4,400	1/3,800	1/110	1/110	—	—

Absorption tests were carried out using living cultures of *Proteus* "OXK" and "OX19" with the following results:

	"K."	"OXK."	"W."	"OX19."
	(Alc.)	(Living.)	(Alc.)	(Living.)
Unabsorbed ...	1/220	1/500	1/1,000 (a)	1/880 (b)
Absorbed with "OXK"	0	0	1/880 (b)	1/680 (c)
Absorbed with "OX19"	1/220	1/500	0	0

The difference in titre recorded in tests (a), (b), (c), represent the difference between "standard", "standard minus," and "trace" agglutination in the same dilution, viz., 1/1,000.

Some confirmation of the "K" nature of the infection was afforded by the Weil-Felix reaction in a passage rabbit, the virus originating from blood taken on the sixth day of the disease.* There was definite development of "K" agglutinins but not of "W" agglutinins. Before inoculation the test was quite negative, but on the twentieth day afterwards the "K" titre had risen to 1/170, and on the thirty-fifth day, it was 1/75. Three other rabbits, inoculated at the same time, unfortunately died of intercurrent infection, but not before it had been possible to demonstrate a rise in titre against "K" living emulsions from nil to 1/85 on the fourteenth day in one animal, and from nil to 1/96 on the eleventh day in another.

* Passage was undertaken by Dr. R. Lewthwaite. A guinea-pig was first inoculated with blood from the case, and four rabbits were injected with virus from the guinea-pig.

This is the first case met with locally which has given high titres with both "K" and "W" strains at the same time, compare tick bite fever in South Africa (Troup and Pijper, 1931). The fact that the "W" titres fell while the "K" titres rose and later fell, suggests the possibility that the "W" agglutinins may have been residual from a former illness, though it is also possible that the infecting virus in this instance contained both "K" and "W" elements in its antigenic structure. This tropical typhus case with simultaneous "K" and "W" agglutinins, came from the area in which Dr. L. Anigstein inoculated a number of the labourers with prophylactic anti-typhus vaccine, but was not employed on the estate until after the date of that experiment.

The Weil-Felix Reaction after Recovery from Tropical Typhus.

Details are given below of the Weil-Felix readings in a number of cases of tropical typhus from which blood was taken after the fortieth day of illness. The first series are from Dr. Lewthwaite's records of cases seen in 1927 and 1928; the second, from cases observed in the present year. The tests in the second series have been carried out with duplicate living and duplicate alcoholized suspensions. From these figures it will be seen that a Weil-Felix reaction of diagnostic titre may be obtained more than a year after the onset of the disease.

TABLE XXXI.

WEIL-FELIX TITRES AFTER RECOVERY.

Series I. (1927 and 1928.)

Serial Nos.	Date and maximum titre observed during illness.		Date and titre of test carried out after 40th day from onset.	
5	28th day	1/3,800	56th day	1/480
8	15th "	1/3,800	71st "	1/120
10	19th "	1/15,000	63rd "	1/120
14	22nd and 39th "	1/7,700	91st "	1/1,920
17	18th "	1/1,900	58th "	1/240
29	26th "	1/61,000	51st "	1/480
59	28th "	1/47,000	69th "	1/960
63	20th "	1/10,500	52nd "	1/1,900
88	19th "	1/30,000	43rd "	1/15,000

Series II. (1931.)

Serial Nos.	Date and maximum titre observed during illness.					Date and titre of test carried out after 40th day from onset.				
	Day.	"K."		"OXK."		Day.	"K."		"OXK."	
		(Alc.)	(Liv.)	(Alc.)	(Liv.)		(Alc.)	(Liv.)	(Alc.)	(Liv.)
174	20th	1/320	...	...	...	374th	1/220	1/385	1/340	1/385
552	17th	1/500	...	...	...	249th	1/250	1/440	1/192	1/385
602	34th	1/140	...	...	...	237th	1/125	1/192	1/170	1/125
645	16th	1/2,800	...	...	...	212th	1/85	1/170	1/140	1/125
593	17th	>1/5,000	...	...	...	269th	1/220	1/220	1/140	1/440
747	9th	1/85	(diagnosis clinical)			221st	1/250	1/770	1/220	1/600
18	7, 13 and 23rd	0	..	..	..	433rd	1/34	1/220	1/34	1/340

Case No. 18 is of particular interest. Diagnosis was made on clinical grounds despite the complete absence of agglutination of "W" and "K" alcoholized suspensions on the 7th, 13th and 23rd day of illness. About 14 months later definite agglutination of living emulsions ("K") was obtained.

The Deterioration of Stock Alcoholized Suspensions.

In contrast with the high concentration of stock alcoholized suspensions of *B. typhosus* for the Widal reaction, the corresponding suspensions of the Weil-Felix reaction have, as a rule, been stored fully diluted and ready for use. Several tests have been made by Dr. P. H. Martin with these diluted suspensions to detect possible absorption of "O" agglutinins from tropical typhus sera by any substance in the supernatant fluid. The technique included centrifuging and filtering through a Seitz filter, and was similar to that used by Bruce White (1931) in connection with *B. typhosus*. The results have been negative: no reduction in titre has been observed. There is thus no evidence of extraction from alcoholized suspensions of *Proteus* "OXK" of any substance which masks or inhibits a positive Weil-Felix reaction, even when the agglutinable suspension has been kept diluted and ready for use. But with saline extracts from very concentrated suspensions of *Proteus* "OXK", heated before separation to 100°C. for half-an-hour, a small reduction in titre of doubtful significance was found to occur.

RE-INVESTIGATION OF STRAIN *PROTEUS* X. 19 "K" IN REGARD TO FORMATION OF INDOL AND FERMENTATION OF SACCHAROSE.

Dr. L. Anigstein, while working in 1930 with *Proteus* X. 19 "K" at this Institute, noted a weak positive reaction for "indol" (ring technique) with a six-day culture. He also obtained late saccharose fermentation. Early in the past year, Professor Snijders of Medan kindly forwarded a sub-culture of the "K" strain which he had originally received from here. Dr. P. H. Martin has re-investigated that strain and also the two stock Institute for Medical Research "K" strains which have been kept in duplicate, but separate, for some years. All three cultures showed the same reactions, and two rabbits, immunised against the culture from Medan and against one of the stock Institute for Medical Research strains, respectively, developed "H" and "O" agglutinins which reacted to equal titre with all three strains in regard to "H" agglutinins. Both gave good "O" agglutination with the three strains though one of the stock Institute for Medical Research cultures was slightly more sensitive to the "O" agglutinins of its homologous serum.

Tests for indol were undertaken using B.D.H. peptone, and on the sixth day of culture, a faint but definite ring of magenta colour was obtained when Ehrlich's reagent was added to form a ring above the culture. Using ether extraction before the addition of the reagent (after six days' incubation), the ring appeared to be in the culture rather than in the ether layer. Further tests were carried out on six-day cultures using Ehrlich's reagent followed by a saturated solution of potassium persulphate and heating in a water bath: within two minutes a definite diffuse magenta colour, which could not be extracted with chloroform, appeared throughout the culture. It was found that an intensified tint was obtained when the reaction was applied to nine, instead of six-day cultures, but it is discernable, both by

the ring and the persulphate and heat techniques, between the sixth and the twelfth day of culture. Mr. R. W. Blair, Chief Chemist, kindly confirmed that the chloroform extract showed no magenta colour: the development of this colour is probably thus not due to indol. The same phenomenon with the ring test for indol has been observed with the "Muar" and the "K 13" strains, to which reference will later be made. These two strains have some antigenic element in common with *Proteus* X. 19 "K".

Saccharose fermentation was essayed employing B.D.H. saccharose, which had unfortunately been in stock for some months. Weak acid production occurred with the three strains after six to seven days incubation and there was also production of a small amount of gas on the eighth to the tenth day. The saccharose was found by Dr. I. A. Simpson to give a slight reduction with Benedict's solution. After purification by alcohol precipitation, Dr. Simpson was unable to find signs of inversion in a 10 per cent. solution, after steaming for the period to which 1 per cent. sugar solutions are subjected in preparation for routine tests. With this purified saccharose acidity also developed in six/seven days.

ISOLATION FROM HUMAN PATIENTS OF ORGANISMS RESEMBLING *PROTEUS* X. 19 "K".

In 1930, Dr. Carvalho forwarded a culture obtained from a case in Muar, Johore, of which Dr. Lander has kindly supplied the following details: The patient was a female Tamil, aged 25, and, on admission to hospital, a provisional clinical diagnosis of influenzal pneumonia was made. An empyema developed, and the organism in question was isolated from pus, smelling of musty eggs, which was evacuated in large quantity. This pus was of too thick a nature to pass freely through an aspirator, and a drainage tube was inserted. Nine days later sloughs were seen in the region of the anus and Dr. Carvalho reports that from these an organism was obtained similar to the one from the empyema pus that he forwarded to this Institute for identification. The Weil-Felix reaction of the patient more than three weeks after admission, and about three months after the reported onset of illness, was positive with an alcoholized "K" suspension to a dilution of 1/280. The serum also agglutinated the "Muar" strain, isolated from her own empyema pus, to a titre of 1/220, but gave no reaction with an alcoholized "W" suspension.

The organism was found to be a short, small cocco-bacillus, highly motile, and Gram-negative. A thin spreading growth occurs on ordinary agar when cultured aerobically at 37°C. or at room temperature (22 to 28°C.). General turbidity develops in broth cultures and stratiform liquifaction of gelatin commences within 24 hours. Fairly good growth is obtainable on glycerin agar, but colonies have little tendency to spread.

Biochemical reactions were as follows—Voges Proskauer—; H_2S +; NH_3 +; Catalase+; Methyl red+; Litmus milk, no change in 48 hours, later decolourisation with digestion by 14th day; Lactose, O; Maltose, O; Saccharose, sixth day, trace

of acidity, 14th day, acid with trace of gas (?); Dulcitol, O; Dextrin, O; Arabinose, O; Adonite, O; Galactose, 24 hours acid and gas; Levulose, 24 hours acid and gas; Inositol, 24 hours acid and gas; Salicin, O; Xylose, 24 hours acid and gas. Indol production is negative, but a trace of colour was noted on the sixth day with the ring test.

When first received, the culture was sensitive to the agglutinins of human tropical typhus ("K" serum):

	"HXX" (living).		"Muar" strain.	
Human serum ...	1/5,600 "O"	...	1/2,800 "O"	
	0 "H"	...	0 "H"	

The sera of two rabbits, immunised by intravenous injection, one with the "Muar" strain and the other with a non-spreading culture of the stock *Proteus* X. 19 "K" Singapore strain (grown on dry agar slopes) gave the following results on cross absorption:

Living suspensions.							
K "O".				"Muar."			
				"H."		"O."	
"Muar" serum unabsorbed	1/3,400	...	1/5,000	...	1/5,000
"Muar" serum absorbed "Muar"	0	...	0	...	0
"Muar" serum absorbed "K" "O"	0	...	1/5,000	...	0
"K" serum unabsorbed	1/3,000	...	—	...	—
"K" serum absorbed "Muar"	0	...	—	...	—
"K" serum absorbed "K" "O"	0	...	—	...	—

The culture "K" "O" Singapore was not spreading at the time and contained very few motile organisms.

Two male rats were inoculated with living 24-hour broth culture of the "Muar" strain. There was slight fever on the fourteenth and fifteenth days but no lesions developed which could be attributed to infection with a typhus-like virus. Passage was made in duplicate with heart blood and liver and spleen emulsions; indefinite fever on the eighth and eleventh days occurred, but, apart from that finding, there were no signs of infection and cultures for *Rickettsia* were all negative. Two guinea-pigs, each inoculated intra-peritoneally with 0.5 c.cms. of a 24-hour broth culture, showed no febrile reaction or other signs of infection. Similar injections were made intra-peritoneally into two rabbits which also received 0.5 c.cms. of the culture sub-cutaneously. Both remained afebrile and neither showed any local or general reaction. Of these rabbits, one only (No. 33/31) gave serological indication of relationship between the "Muar" and "OXK" strains.

				Alcoholized suspensions.		
Rabbit 32/31.				"K."		"W."
Before inoculation ...	...	...	...	1/28	...	0
On 14th day ...	...	...	...	1/56	...	0
On 19th ,, ...	...	...	...	1/85	...	0

				Alcoholized suspensions.		
Rabbit 33/31.				"K."		"W."
Before inoculation ...	...	...	...	0	...	0
On 15th day ...	...	...	...	1/2,200	...	0
On 21st ,, ...	...	...	...	1/1,300	...	0

A second strain (from patient No. "K 13"), also having serological relationship with *Proteus* "OXK", has been isolated from a male Chinese, aged 26, who was diagnosed clinically as a case of leprosy. The right leg was anaesthetic and the right foot swollen and deformed, with a discharging sinus under the instep. The tissues of the foot appeared to be disintegrating. From the discharge, on two occasions, was isolated a bacillus, which spread as a thin film over the surface of solid medium. This organism measured about $1\mu \times 3$ to 4μ , i.e., rather longer than young culture forms of the "K" and "Muar" strains. It was Gram-negative and grew readily on broth agar under aerobic conditions at 37°C . and also at room temperature (22° to 30°C .). Uniform turbidity developed in broth cultures, and a deposit formed at the bottom of the tube by the sixth day. In gelatin infundibuliform liquefaction commenced within 24 hours.

The biochemical reactions were as follows: Voges Proskauer, -; H_2S +; NH_3 +; Methyl red, +; Litmus milk, no change in four days, slight alkalinity on seventh day and decolorization on thirteenth day; Glucose, 24 hours acid; Galactose and levulose, 48 hours acid; Lactose, mannite, maltose, saccharose, dulcitate and salicine, all negative up to fourteenth day; Indol production, trace of colour obtained on sixth day, but chloroform solubility was not tested.

Agglutination and absorption with human tropical typhus ("K") serum and with rabbit "K" immune serum showed that this organism contained some element which could be agglutinated by, and which absorbed to some degree, the "O" agglutinins in the two sera.

		Weil-Felix.				"K 13" (Living).
		Proteus "HXK" (Alic.).	"K" (Spore) (Living).			
Tropical typhus "K" patient's						
serum unabsorbed	...	1/17,000	...	1/19,000	...	1/5,000 "O"
Absorbed, "K 13"	...	1/4,000	...	1/4,400	...	0
Rabbit immune serum "K"						
unabsorbed	...	1/5,000	...	1/4,400	...	1/3,400 "O"
Absorbed, "K 13"	...	1/1,300	...	1/1,900	...	0

Negative Weil-Felix readings with both "K" and "W" strains were given by the serum of the patient.

The presence in this country of such organisms may afford an explanation for the rather large number of human sera that agglutinate the "K" strain of *Proteus* X. 19 to a titre, which, though too low to be diagnostic of a typhus-like infection, is yet high enough to be suggestive, thus necessitating the repetition of the Weil-Felix reaction at a later date.

ENTERIC FEVERS.

The Widal Reaction.

An analysis has been made by Dr. P. H. Martin of the serological results from about 150 cases of enteric fever diagnosed by him in the past year. The technique employed was as described on page 55 of the previous annual report. At

intervals, serum controls were put up against the various suspensions while saline controls, to a concentration of four times normal were used weekly. Normal saline controls were, of course, put up with every test.

The Suspensions.

In addition to the standardised alcoholized suspension of *B. typhosus* and the "H" emulsions of *B. typhosus* and *B. paratyphosus* A, B and C, an alcoholized suspension of *B. paratyphosus* A was included in all tests for seven months of the year. This alcoholized suspension was agglutinated by immune rabbit serum and, in the routine tests, it was frequently agglutinated by sera containing Typhosus "O" agglutinins. In the seven months, however, no serum has been found to give "O" agglutination with this emulsion which did not also show positive agglutination with the Typhosus "O" suspension.

At the end of 1930, a batch of *B. typhosus* alcoholized suspension prepared in the preceding April was observed to have deteriorated. The emulsion had been kept in a household type electric refrigerator except when actually in use. It is probable that the deterioration was due to slow extraction of the substance capable of binding "O" agglutinins, described by Bruce White (1931).

Towards the end of July of the year under review, deterioration was again noted in a batch of emulsion which had been prepared in February, and, as in the former case, stored in a household refrigerator. This emulsion was concentrated and required dilution with normal saline to 1/20 before use. Part of the batch was centrifuged and the supernatant fluid passed through a Seitz filter. The titre of a typhoid fever patient's serum was reduced, by contact with the filtrate, from 1/560 to 1/80. No precipitin reaction was obtainable by the addition of the fluid to the patient's serum. Again, early in November still another batch of Typhosus "O" alcoholized suspension was found to have deteriorated. In this case, the centrifuged and filtered fluid, by contact with a typhoid patient's serum, brought about a reduction in titre for Typhosus "O" from 1/800 to 1/250, and, on a second occasion, from 1/800 to 1/440. Re-suspended bacilli from the deteriorated suspensions have been found to be agglutinable.

Two Enteric Cases presenting Interesting Serological Features.

The first case was a male Chinese, aged 29 years. The Weil-Felix was negative throughout the illness, and the Widal findings at intervals up to the 87th day after onset are given below:

Day of disease.	Typhosus.				"H" Paratyphosus.					
	"O" R.T.		"H."		"A."		"B."		"C."	
17th	...	5	...	1/1,130	...	0	...	0	...	1/110
24th	...	5	...	1/680	...	0	...	0	...	1/56
51st	...	0	...	1/85	...	0	...	0	...	0
55th	...	0	...	1/110	...	0	...	1/17	...	1/150
76th	...	13	...	1/5,600	...	0	...	1/34	...	1/17
87th	...	21	...	1/6,000	...	0	...	1/30	...	0

Clinically, the case was throughout one of enteric fever. There was a primary wave of fever which lasted until the twenty-eighth day, followed by a relapse which began on the forty-fifth day and lasted for thirteen days. A second relapse commenced on the sixty-eighth day, and it was not until this second relapse that the Widal became strongly positive for both "H" and "O" agglutination. *B. typhosus* was isolated from a specimen of faeces on the fifty-fifth day, i.e., prior to the second relapse. The temperature chart of the primary attack and of each relapse showed a typical continued fever. The patient was discharged from hospital on the 130th day.

The second case was a male Malay. The clinical diagnosis of typhoid fever was confirmed by the Widal reaction. On the twenty-third day of illness the Typhosus "O" Reduced Titre was 220. On the forty-ninth day, when the patient was convalescent and prepared to return to his work as house-boy, the Typhosus "O" Reduced Titre was found to be 18. It was therefore suggested that he might still be infectious, and a few days later *B. typhosus* was isolated from the excreta. Two months later, the Typhosus "O" Reduced Titre was 9, and after a further six weeks it had fallen to five. The "H" agglutination titres corresponding to the last three "O" Reduced Titre readings were 1/320, 1/50, and 1/19. Further specimens of excreta were obtained and examined with negative results, though, forwarded as they were from a distance of some 80 miles, plating was delayed and the results are consequently less reliable.

Typhosus "O" Reduced Titre Readings in Paratyphoid Fever.

A few cases of paratyphoid fever have been specially investigated from the point of view of Typhosus "O" Reduced Titre readings. Soon after the introduction in April, 1930, of a satisfactory alcoholized Typhosus "O" suspension, standardised against a suspension from the Standards Laboratory, Oxford, two cases of *B. paratyphosus* A infection were diagnosed on the basis of paratyphoid A "H" agglutination, plus a reaction with a Typhosus "O" alcoholized suspension to reduced titres of 16 and 14. *B. paratyphosus* A was isolated from the excreta of both these cases.

A third case also showed strong *Paratyphosus* A "H" agglutinins but no reaction with Typhosus "O", although *B. paratyphosus* A was isolated from the blood on the twenty-eighth day of disease—the first occasion on which a specimen had been submitted. In order to determine whether there was any antigenic difference between these three strains of *B. paratyphosus* A, three rabbits were immunised against the three cultures. The sera of all three animals showed strong agglutination of Typhosus "O" (No. 1, R.T. 220; No. 2, R.T. 220; and No. 3—immunised with the strain from the patient without Typhosus "O" agglutinins—R.T. 250). The culture from this third patient was found to absorb the typhosus "O" agglutinins from the sera of the first two rabbits. The difference in agglutinins response of the human case would thus appear, in this instance, to be due to idiosyncrasy.

The following cases also showed *B. paratyphosus A* "H" agglutinins and that organism was isolated from some; others were diagnosed clinically as paratyphoid fever. The Typhosus "O" Reduced Titre readings, and the days of disease, on which the specimens were taken, are given below:

TABLE XXXII.

Case No.	Day of disease.	Typhosus "O" R.T.	<i>Paratyphosus A</i> "H".
159	45th	0	1/5,000
	52nd	8	1/5,000
	66th	2	1/3,400
322	22nd	4	1/340
	34th	4	1/140
421	21st	12	0
	31st	34	1/280
	45th	17	1/170
108	28th	0 (a)	1/5,000
	39th	0	1/3,400
851	8th	0 (b)	1/10
	16th	0	1/220
766	8th	0	1/1,000
	14th	0	1/880

(a) *B. paratyphosus A* isolated from Widal blood.

(b) *B. paratyphosus A* isolated from faeces.

It thus appears that the production of group Typhosus "O" agglutinins in *paratyphosus A* cases is very variable.

High Typhosus "O" Titres in Cases not known to be Infected.

A Typhosus "O" Reduced Titre of 15 was obtained with the serum of a European, who showed no signs of enteric infection and who gave a negative history of prophylactic vaccination and of previous attack of enteric fever. His excreta were cultured without success.

Another European, suffering from Japanese river fever, which was confirmed later by a positive Weil-Felix reaction with the "K" strain, showed the following Typhosus "O" Reduced Titres—eighth day, 13; tenth day, 14; seventeenth day, 14; twenty-third day, 21; forty-eighth day, 7. A rise in titre of "H" agglutinins with *B. paratyphosus A* from 1/2,800 to 1/28,000 also occurred, while other "H" enteric agglutinins were present and showed small increases during the course of the disease. No enteric organism could be isolated from Widal blood clot cultures on five occasions, nor from faeces or urine cultures on two occasions. This case had been vaccinated against enteric fever three years prior to the illness.

The Medical Officer-in-Charge was unable to find symptoms or signs pointing to enteric infection. In view of the cases reported by Peverelli (1930), the case is of particular interest, though the ulcer, fever, general condition of the patient, and the result of the Weil-Felix reaction, place the diagnosis of Japanese river fever on very firm ground.

The Widal Reaction in Tropical Typhus.

Several sera from cases which later gave a positive Weil-Felix reaction and, in which the clinical diagnosis has been tropical typhus, have shown a Reduced Titre for Typhosus "O" suggestive of enteric infection. But whereas "H" agglutinins for the enteric group tend to rise during the course of tropical typhus, several cases have been noted in which an initially suggestive Typhosus "O" R.T. reading has fallen later in the disease.

—	R.T. T. "O."	Widal Reaction.				Weil-Felix.		
		T(H).	A(H).	B(H).	C(H).	"K."		"W."
						(Alc.)	(Liv.)	(Alc.)
(A 950), Male Tamil 30 years.								
10th day	7	0	0	1/280	1/280	1/26	1/140	0
18th "	4	0	0	1/340	1/500	1/2,800	1/2,500	1/17
(A 1135), Male Tamil 24 years.								
12th day	5	1/150	0	1/25	0	1/50	1/125	1/19
17th "	0	1/1,130	0	0	0	1/3,800	1/3,400	1/22
(A 657), Male Tamil 32 years.								
13th day	11	1/56	1/25	1/25	1/56	0	...	0
23rd "	No reading	1/110	0	1/250	1/256	1/1,300	...	1/19
38th "	4.5	1/56	0	1/56	1/56	1/140	1/340	1/32
(A 1137), Male Tamil 28 years—clinical diagnosis, tropical typhus and benign tertian malaria.								
11th day	9	1/44	0	0	0	1/25	1/35	0
17th "	4	1/38	0	0	0	1/125	1/90	1/17
30th "	3	0	0	0	1/30	...	1/240	
(A 17a), Male Tamil 40 years.								
17th day	10	0	1/17	0	0	1/1,150	1/720	
24th "	4	0	1/4,400	0	0	(?) 1/440	1/1,100	

On the other hand, a case has been encountered, a male Tamil, aged 26 years, in which the Typhosus "O" R.T. readings increased as the disease progressed (a similar finding to that recorded above for a case of Japanese river fever). The diagnosis of tropical typhus was confirmed by the Weil-Felix reaction, and the Medical Officer-in-Charge of the case reported that there were no abdominal or other signs suggestive of enteric fever. The following are the findings:

—	R.T. T. "O."	T(H).	A(H).	B.	C.	"K."		"W."
						(Alc.)	(Liv.)	
9th day	0	0	0	0	0	1/56	1/56	1/30
16th "	4	0	0	0	0	1/500	1/880	1/25
22nd "	12	1/25	0	0	0	1/730	1/1,130	1/22
29th "	15	0	0	0	0	1/560	...	1/28

After the twenty-second day of illness the excreta were examined on three successive days. No enteric organisms were isolated, though a bacillus giving the biochemical reactions of *B. morgani* was obtained.

Two other cases have shown at a single observation a significant Typhosus "O" Reduced Titre at the same time as positive Weil-Felix reactions. The first was a male Tamil, aged 26; the second, a female Tamil, aged 25.

—			R.T. T. "O".	T (H).	A (H).	B.	C.	"K."		"W." (Alc.)
								(Alc.)	(Liv.)	
CASE I.										
21st day	...	...	10	0	0	0	1/440	1/180	1/560	0
CASE II.										
12th day	...	...	15	0	1/125	0	1/30	1/380	1/700	1/800

When, in the course of tropical typhus, Typhosus "O" R.T. agglutinins persist at a suspiciously high level or actually rise, the case may possibly be found on thorough investigation to be a carrier of enteric organisms.

THE ISOLATION OF ENTERIC ORGANISMS FROM BLOOD SPECIMENS SUBMITTED FOR SEROLOGICAL EXAMINATION.

Following the work of Lesslar at this Institute, cultures have been made from a number of specimens of blood received for the Widal and Weil-Felix reactions. After separation of the serum for serological test, bile medium was added to the residual serum and clot and the culture incubated at 37°C. Sub-cultures on plates were made during the following morning.

In cases where "O" agglutinins had not yet developed, the results have been disappointing. The delaying of taking specimens until about ten days after the onset of disease, in order that agglutination tests may show significant figures, is the probable explanation. With the former technique in use for the Widal reaction, which detected "H" agglutinins almost exclusively, a positive reaction was not to be expected until well into the second week of illness. And the Weil-Felix reaction, which is frequently the alternative laboratory test from which assistance may be expected, does not usually become diagnostic until the patient is nearing convalescence in the third week of the disease.

A further possible reason for the paucity of positive results may be the presumably extraneous organisms which have been so frequently encountered. Of 1,276 specimens cultured, 650 proved to be sterile, 599 yielded organisms not of the enteric group, and only from 27 cases (about 2.4 per cent.) were organisms of the enteric group isolated. In 434 instances records are available of the presumably extraneous organisms. Lactose fermenters, organisms of the Subtilis group, Staphylococci, and the Pyocyanaceous group were obtained from 180, 123, 99 and 30 specimens respectively.

The cultures positive for enteric organisms have usually been obtained from specimens giving both "H" and "O" agglutinins; but the following five cases demonstrate the value of such cultures, when the Widal readings have not reached diagnostic limits.

TABLE XXXIII.

CORRELATION OF WIDAL RESULTS WITH POSITIVE CLOT CULTURES.

Case No.	Day of illness.	Typhosus.		"H" Paratyphosus.			Remarks.
		"O."	"H."	"A."	"B."	"C."	
		R.T.					
137	8th	0	1/50	0	0	0	<i>B. typhosus</i> isolated
	15th	20	1/680	0	0	0	
	29th	85	1/2,500	0	1/17	1/25	
550	10th	5	1/85	0	1/25	0	" "
	19th	56	1/250	0	0	0	
613	10th	3	1/34	0	0	0	" "
	15th	3	1/1,130	0	0	0	
	25th	3	1/560	0	1/22	0	
770	14th	0	1/1,000	0	0	0	" "
	22nd	3	1/280	0	0	0	
	27th	0	1/140	0	0	0	
894	15th	5	1/770	1/34	0	0	" "
	23rd	5	1/500	0	0	0	
108	28th	0	0	1/5,000	0	0	<i>B. paratyphosus A</i> isolated
	39th	0	0	1/3,400	0	0	

Other Typhosus "O" R.Ts., at the time of positive clot cultures, have varied between 56 and 12. The results have been generally confirmatory of Felix's view that septicaemia diminishes as "O" agglutinins develop.

PNEUMONIA.

Treatment with a Concentrated Preparation of Vitamin "A".

Numerous observers, working with laboratory animals, have recorded a relationship between experimental vitamin "A" deficiency, and a lowered resistance to respiratory and intestinal infections. This lowered resistance appears to depend on a degradation in type of the surface epithelium of the respiratory and intestinal tracts; a histological change which is regarded as a specific result of devitaminosis "A". Vitamin "A" may thus be considered to have prophylactic value against these infections; that it will prevent the broncho-pneumonia which is a common terminal infection in vitamin "A" starved rats, has been convincingly demonstrated by Green and Mellanby. It has been suggested that vitamin "A" may be of value in the treatment of established infections, though this view has met with opposition on the ground that vitamin "A" is of value only in so far as it can maintain the integrity of mucous membranes, and plays no part in stimulating the general humoral defences.

The ensuing observations made by Dr. J. W. Field on the treatment of a series of pneumonia patients with a proprietary preparation rich in vitamin "A", were designed to test the validity of that view. Pneumonia admissions to the District Hospital, Kuala Lumpur, during the five months, June to October, 1931, were included in their due sequence, and without selection, in three series—an "A", or vitamin "A" treated series, a "B" series, which will be discussed later, and a "C" or control series. The "A", "B" and "C" series were treated on conservative lines as nearly standardised as was reasonable with a disease such as pneumonia which may elicit in different individuals physical responses of so diverse a nature. The "A" series, in addition received one daily dose subcutaneously, of "Radiostoleum", a proprietary preparation said to have 20 times the vitamin "A" content and 100 times the vitamin "D" content of good cod liver oil. The numbers treated (*see* Tables Nos. XXXIV and XXXVI) are obviously too small to be statistically significant. The most that can be said is that the results offer no support for the view that vitamin "A" has appreciable value in the treatment of pneumonia.

TREATMENT WITH INTRAVENOUS BILE SALTS SOLUTIONS.

It has long been known that bile salts have a solvent action on the pneumococcus. The fact has been turned to clinical advantage by Ziegler, who has recorded the treatment, with apparent success, of a small number of pneumonia patients with intravenous bile salts. This observer is of opinion that the presence in the blood serum of bile salts during the course of pneumococcal pneumonias, is related to the immunity mechanism of the body towards this disease; a view supported by the finding of Elton, that the icteric index rises in pneumococcal but not in influenzal pneumonia, and is highest at the time of crisis.

The following records cover a small series (B) of pneumonia cases treated by the courtesy of the Medical Officer, District Hospital with intravenous injections of a 10 per cent. solution of sodium choleate. The results obtained by Dr. J. W. Field are summarised in Table No. XXXV. There is as yet no indication that intravenous injections of this salt appreciably affect the course of the disease, though clinically the impression—not supported by the statistics—has been gained that the severity of the disease was somewhat mitigated. Whether this apparent benefit compensates for the venous thrombosis which sometimes occurs as a result of the injections (Case B7) is a matter for further observations. It is surprising that the bile salts appeared to have little effect on the blood pressure; the cardiac depression which was anticipated, did not occur.

The case mortality throughout the three series was unusually low, viz., 18 per cent. It is not regarded as due to any change in the management or treatment of the cases, or to change in the standards of diagnosis, but is more probably explicable by periodic variation in the severity of the disease.

The bacteriology of the cases treated is summarised in Table No. XXXVII.

TABLE XXXIV.
TREATMENT WITH VITAMIN "A".
(Series A.)

Case No.	Sex, nationality and age of cases, and condition on admission.				Degree of lung involvement.				Day of disease temperature commenced to fall.			Degree of resolution on discharge.	Total dosage radiostoleum.	Remarks.
					I, Congestion: II, Lobular consolidation: III, Lobar consolidation.				Crisis.	Rapid lysis.	Slow lysis.			
					R.U.L.	R.M.L.	R.L.L.	L.U.L.						
A1	Male	Tamil	30	Fair	...	...	I	...	III	...	...	...	20 cc.	Died from pneumococcal meningitis on 23rd day of disease
A2	"	Kheh	18	"	I	I	II	I	II	11	...	Incomplete	20 cc.	Recovered
A3	"	Tamil	27	Good	...	...	III	...	I	...	...	18	20 cc.	"
A4	"	Hylam	38	Poor	III	I	I	...	...	...	...	...	4 cc.	Died within 24 hours of admission. P.M.: Grey hepatisation R.U.L. Multi-lobular cirrhosis liver
A5	"	Tamil	40	Fair	I	I	II	I	II	...	...	Incomplete	20 cc.	Recovered
A6	"	"	35	Good	I	I	III	...	...	...	8	"	20 cc.	"
A7	"	"	27	"	...	...	II	...	II	...	...	"	20 cc.	"

TABLE XXXV.
TREATMENT WITH BILE SALT SOLUTION.
(Series B.)

Case No.	Sex, nationality and age of cases, and condition on admission.				Degree of lung involvement.						Day of disease temperature commenced to fall.			Degree of resolution on discharge.	Total dosage sodium choleate.	Venous complications.			Result.
					I, Congestion : II, Lobular consolidation : III, Lobar consolidation.											Local pain.	Local oedema.	Oedema forearm hand.	
					R.U.L.	R.M.L.	R.L.L.	L.U.L.	L.L.L.	Crisis.	Rapid lysis.	Slow lysis.							
B1	Male	Tamil	...	25	Fair	I	I	III	I	III	...	...	13	Incomplete	8 gms.	+	+	—	Recovered
B2	"	"	...	25	Poor	I	I	I	I	II	...	...	...	"	3 gms.	+	+	—	"
B3	"	"	...	22	Fair	I	I	...	III	I	...	...	14	"	4 gms.	—	—	—	"
B4	"	"	...	32	"	...	...	I	...	I	...	7	...	Complete	4 gms.	+	+	—	"
B5	"	"	...	21	Poor	I	I	II	I	II	...	...	19	"	8 gms.	+	+	—	"
B6	"	Singhalese	...	28	Fair	...	...	III	...	...	...	10	Incomplete	"	4 gms.	—	—	—	"
B7	"	Tamil	...	30	Good	...	...	II	...	II	...	15	"	"	6 gms.	+	+	+	"
B8	"	"	...	20	Fair	...	...	I	...	III	...	...	...	...	4 gms.	—	—	—	Died

TABLE XXXVI.
CONTROL CASES.
(Series C.)

Case No.	Sex, nationality and age of cases, and condition on admission.					Degree of lung involvement.					Day of disease temperature commenced to fall.			Degree of resolution on discharge.	Remarks.
						I, Congestion : II, Lobular consolidation : III, Lobar consolidation.					Crisis.	Rapid lysis.	Slow lysis.		
						R.U.L.	R.M.L.	R.L.L.	L.U.L.	L.L.L.					
C1	Male	...	Tamil	...	45	Fair	...	...	I	...	8	...	Incomplete	...	Recovered
C2	"	...	"	...	30	Good	...	...	II	...	...	...	"	...	"
C3	"	...	"	...	11	"	...	I	...	10	...	...	Complete	...	"
C4	"	...	"	...	40	Fair	...	...	III	...	13	15	Incomplete	...	"
C5	"	...	"	...	22	Good	...	...	II	...	...	...	Complete	...	"
C6	"	...	"	...	32	Fair	...	I	...	...	...	...	...	...	"
															Died unexpectedly on day of admission. P.M.: Red hepatisation R.L.L.
C7	"	...	"	...	28	"	...	...	II	...	15	...	Unresolved	...	Recovered

TABLE XXXVII.
BACTERIOLOGICAL RESULTS FROM CASES TREATED.

No.	Pneumococcus isolated.	Type.	Fermentation Reactions.								Other organisms.	Clinical result.	
			Lactose.	Salicin.	Mannite.	Inulin.	Raffinose.	Litmus Milk (Acid and Clot).	Bile Solubility.	Haemolysis.			Capsule.
A1	Yes ...	... IV	+	-	-	-	+	+	+	+	+	...	D.
A2	Yes ...	... I	+	-	-	-	+	+	+	+	±	...	R.
A3	Yes ...	I.M.R. II	+	-	-	-	+	+	+	+	±	...	R.
A4	Yes ...	... G. VII	+	-	-	+	+	+	+	+	+	...	D.
A5	Yes ...	... II	+	-	-	+	+	+	+	+	±	...	R.
A6	Yes ...	... III	+	-	-	-	+	+	+	+	±	...	R.
B7	Not examined	...	...	...	...	...	...	...	...	...	...	...	R.
B1	Yes ...	I.M.R. II	+	-	-	+	+	+	+	+	+	...	R.
B2	Yes ...	... B. 55	+	-	-	-	+	+	+	+	±	Streptococci <i>B. influenzae</i>	R.
B3	Yes ...	... I	+	-	-	-	+	+	+	+	+		R.
B4	No ...	...	...	...	...	...	...	...	...	...	...	” ”	R.
B5	Yes ...	... II	+	-	-	-	+	+	+	+	-	...	R.
B6	Yes ...	... I	+	-	-	+	+	+	-	+	-	...	R.
A7	Not examined	...	...	...	...	...	...	...	...	...	...	...	R.
B8	Not examined	...	...	...	...	...	...	...	...	...	...	...	D.
C1	No ...	...	...	...	...	...	...	...	...	...	...	Streptococci <i>B. influenzae</i>	R.
C2	Yes ...	... II	+	-	-	+	+	+	+	+	±		R.
C3	No ...	...	...	...	...	...	...	...	...	...	...	...	R.
C4	Yes ...	I.M.R. II	+	-	-	-	+	+	+	+	±	...	R.
C5	Yes ...	... I	+	-	-	+	+	+	-	+	-	...	R.
C6	Yes ...	... II	+	-	-	-	+	+	+	+	-	...	D.
C7	Yes ...	Auto-agglutinable	-	-	-	+	+	+	-	+	-	...	R.

THE TYPING OF PNEUMOCOCCI.

The typing of local strains of pneumococci has been continued during the year, and 75 strains have been isolated and investigated in regard to type and biochemical reactions. As in the previous year, grouping has been based on Dr. Griffiths' and Miss G. Cooper's types, and the following results have been obtained: type I, 9 strains; type II, 24 strains; type III, 8 strains; type IV, 8 strains; type VII, 6 strains; type IX, 1 strain; type X, 3 strains; L. 41, 2 strains; B. 55, 1 strain; PN. 292, 2 strains; I.M.R. I, 7 strains; I.M.R. II, 5 strains. Four of the strains were found to be auto-agglutinable.

ANTHRAX.

B. anthracis has rarely been encountered in medical or veterinary practice in the Federated Malay States. During the past year, however, a strain was isolated from a post-mortem specimen submitted by the Government Veterinary Surgeon, Selangor.

Cases have also been observed among cattle in the Ipoh district of Perak. In the month of March a bullock from the Ipoh Dairy Reserve in Kampong Bahru died under suspicious circumstances, and from post-mortem material *B. anthracis* was

obtained. In May and in August further isolated cases occurred among buffaloes that had grazed on the ground attached to the Ipoh abattoir. The infected animals came originally from Siam. They had been imported some six weeks previously and had been quarantined for twelve days at the Coast.

DIPHTHERIA.

The Local Forms of *C. diphtheriae*.

An attempt has been made by Dr. P. H. Martin to classify the strains obtained from positive swabs, and 19 cultures from cases of diphtheria and six from contacts have been isolated and examined. These strains have been compared with reference to morphology; the time taken for the development of alkalinity to phenol red in broth cultures; haemolysis, as observed on Kirschner's medium and as described by Anderson and Happold and others; fermentation of dextrin, starch, saccharose, glucose, galactose, and maltose; and the hydrolysis of starch. No clear-cut classification of the strains has been possible and no strain as yet isolated confirms exactly to the reactions of the *gravis* type. Several cultures appear to be of the *mitis* type and many gave intermediate reactions. The number of cases found positive monthly in the Kuala Lumpur district was as follows: 5, 1, 3, 4, 10, 4, 4, 7, 1, 8, 2, 6, i.e., a total of 55 cases in the year. A questionnaire was addressed to Lady Medical Officers and Medical Officers in the area, requesting information regarding the relative frequency of the *gravis* and *mitis* clinical pictures. The *gravis* picture was not seen during the last quarter of the year when strains were being investigated.

The Schick Test.

Between April and July, 300 Malay boys, of ages varying from 5 to 13 years, from a school in Kuala Lumpur were tested with material (capillary sets) obtained from Messrs. Burroughs and Wellcome. In December a re-test was made on 17 boys who had given positive reactions earlier in the year, and only eight were then found to be positive. This re-test was carried out in duplicate and simultaneously on each boy. For the duplicate test, Schick toxin was used, which had been diluted before despatch by Dr. O'Brien of the Wellcome Research Laboratories. It arrived by ordinary mail and had been stored for two months prior to use, in a refrigerator operating between -2°C . and $+10^{\circ}\text{C}$. There was complete agreement in the results of the duplicate tests.

The fact that only half the boys, who had reacted six to eight months previously, proved positive on re-test is not yet explained. The readings of the original test were made at three and ten days' interval after injections, and, of the re-test, after three, seven and twenty-one days. No cases of diphtheria are known to have occurred in the school in the interval between tests, and no cases have been reported from the Kampong Bahru area, in which live practically all the boys' families.

Later, all the cases that had given positive or doubtful results on first testing were again re-tested. Of 36 previously Schick-positive boys, 13 were found to be negative on this re-test, and all previously doubtful reactors had also become negative. Thus, among a group of Malay boys, about 40 per cent. of positive reactors became negative within a period of about eight months. This finding lends support to the view expressed by Fletcher (1927) that diphtheria had been endemic in Malaya for many years and that the population was highly immune.

LEPROSY.

Attempted Transmission to Rats.

Following the discussion at the Leonard Wood Memorial Conference in Manila on future research on leprosy, it was decided to attempt infection of rats kept on vitamin deficient diet. With the collaboration of Dr. I. A. Simpson, batches were put on diets deficient in vitamin A, B, and C, while a further batch was given a well-balanced diet. Dr. G. A. Ryrie kindly co-operated by supplying material for the attempted infections which was obtained by the excision of nodules from acutely reacting cases of leprosy. This material was ground in a mortar, emulsified in saline, and centrifuged at low speed in order to separate out the larger masses of epithelial cells. The resulting emulsion was carefully counted and found to contain 80,000 bacilli per c.cm. (average of three counts). Each batch consisted of six rats, and of these, Nos. 1 and 2 were inoculated intra-cutaneously (left ear) with 0.1 c.cm. of this emulsion after heating to 100°C. for one hour. Nos. 3, 4 and 5 of each batch were similarly inoculated with unheated emulsion, and a quantity of the emulsion was sprayed into the nostrils of No. 6.

Some six weeks later, in order to explore the effect of repeated inoculation, further material was obtained from the leprosarium and treated in a like manner. This second emulsion contained 2,000,000 bacilli per c.cm. (average of three counts) and Nos. 1 and 3 of each batch were inoculated with 0.1 c.cm. intra-dermally into the left ear. Nos. 2 and 4 received the same quantity into the skin of the right ear, and No. 6 was again subjected to intra-nasal spraying. As in the first inoculations, the emulsion given to Nos. 1 and 2 had been previously heated to 100°C.

The experiment still continues; the animals have long since shown clinical indication of vitamin deficiency, and a few of them have died. But careful examination of the sites of inoculation has, up to the present time, been negative except for occasional slight puckering and, in one or two instances, the apparent formation of minute nodules. In these cases histological examination has revealed some endothelial proliferation but, apart from one instance in which death occurred shortly after inoculation, no acid fast bacilli had been found in the ears or in the organs though in one case a few acid fast granules were seen. Up to the present time it appears that the vitamin-deficient batches are in no way less resistant to infection than are normal rats.

DE-SENSITIZATION OF REACTING CASES.

There is good reason to assume that the phenomenon of the lepra reaction is not unconnected with anaphylaxis, and an attempt is being made to abort, and defer the recurrence of reactions by de-sensitization. Oriel and Barber (1930) have obtained a proteose from urine which, when given intra-dermally in minute doses, is said to improve certain skin diseases. Dr. F. E. Byron kindly prepared an extract of proteose from the urines of a number of leper cases in the reacting phase. By the technique adopted, the dilution of the proteose in the final solution was probably about 1/100. Dilutions of 1/1,000, 1/10,000, 1/100,000 and 1/1,000,000 in carbol saline were prepared and tested by superficial scarification on the skin of reacting cases. Extracts were made from the urines of six individuals and it was found that some cases showing the lepra reaction gave optimum reactions with one and others with another of the urinary extracts. The extract causing maximum reaction was selected for each individual case, and 0.2 c.cm. was injected intra-dermally of that dilution which gave a very faintly positive dermal test. Increasing quantities have, as far as possible, been injected at weekly intervals and, although the duration of treatment is short, certain cases appeared to have been benefited.

TUBERCULOSIS.

Analysis of Post-mortem Findings.

Dr. S. R. Savor has prepared an analysis of the post-mortem findings on cases of tuberculosis, examined by the staff of the Institute during the past six years. There have been 471 autopsies, of which 62 per cent. were on Chinese and 38 per cent. on Tamils—it will be remembered that in urban areas Chinese outnumber the Tamils. The age incidence of these cases is shown in the following table:

TABLE XXXVIII.

Age.	Chinese.				Tamils.			
	Number.		Percentage of total Chinese autopsies.		Number.		Percentage of total Tamil autopsies.	
1-10	...	3	...	1.0	...	8	...	4.4
11-20	...	4	...	1.3	...	16	...	8.8
21-30	...	57	...	19.8	...	73	...	40.2
31-40	...	79	...	27.5	...	51	...	28.0
41-50	...	86	...	29.8	...	19	...	10.4
51-60	...	47	...	16.2	...	11	...	6.0
61-70	...	9	...	3.1	...	3	...	1.6
Over 70	...	4	...	1.3	...	1	...	0.6

Of these cases, 3.5 per cent. of the Chinese and 1.3 per cent. of the Tamils were females. It cannot be assumed, however, that a lower incidence obtains among the female population: the figures are explicable by the small numbers of that sex seeking admission to the hospitals.

Two hundred and forty-two cases were predominantly pulmonary in type and 147 were pulmonary with additional well-marked intestinal lesions. Pulmonary tuberculosis thus accounted for over 80 per cent. of the total and these cases fell into the following groups, acute miliary tuberculosis, 10 per cent.; tubercular broncho-pneumonia and acute phthisis (caseation and excavation with little fibrosis), 24 per cent.; chronic ulcerative phthisis (cavitation with much fibrosis) 55 per cent.; fibroid phthisis (marked fibrosis with or without areas of calcification) 11 per cent.

Intestinal tuberculosis, with lesions in the ileum and/or colon, amounted to 4 per cent. of the series, and generalised tuberculosis, with lesions in many organs, for 8 per cent. Genito-urinary tuberculosis, i.e., cases with marked lesions in the genital or renal regions, but with few elsewhere, accounted for 1 per cent.; bone tuberculosis totalled 2 per cent.; meningeal tuberculosis, 1 per cent.; peritoneal tuberculosis, 1 per cent., and glandular tuberculosis, $\frac{1}{2}$ per cent.

The following table indicates the distribution of tubercular lesions in the various organs other than the lungs—omitting the cases of generalised tuberculosis. Diagnosis was macroscopic, except in a few doubtful instances where histological confirmation was obtained :

TABLE XXXIX.

Glands—							
Bronchial	...	...	...	...	...	...	269 cases
Cervical	...	...	...	...	...	...	64 „
Mesenteric	...	...	...	...	...	...	146 „
Others	...	...	...	...	...	...	29 „
Bladder	...	...	...	...	...	...	2 „
Brain (other than tubercular meningitis)	...	...	...	...	...	...	7 „
Heart	...	...	...	...	...	...	1 „
Kidney	...	...	...	...	...	...	41 „
Larynx	...	...	...	...	...	...	16 „
Liver	...	...	...	...	...	...	21 „
Pancreas	...	...	...	...	...	...	2 „
Pericardium	...	...	...	...	...	...	2 „
Peritoneum (other than tubercular peritonitis)	...	...	...	...	...	...	7 „
Spleen	...	...	...	...	...	...	35 „

Sixty-seven per cent. of cases showed thickening of the pleura and in 7 per cent. there was evidence of recent pleurisy.

Pancreas	2 cases
Bladder	2 „
Pericardium	2 „
Heart	1 „

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MELIOIDOSIS.

Three cultures have been received from Dr. de Moor of Batavia, which he suspected to be *B. whitmori*. Federated Malay States strains of this bacillus were also sent to Dr. de Moor and to Dr. Bonne of the Pathological Institute, Batavia. Dr. P. H. Martin has investigated the properties of the cultures. Biochemically, the Java strains appear indistinguishable from the strains of *B. whitmori* isolated in this country. There is also similarity in regard to virulence to guinea-pigs and in the lesions produced. Serologically, all strains are agglutinated to approximately the same titre ("O" type of agglutination) by rabbit's immune serum prepared with an Institute for Medical Research strain.

A careful comparison was made of the three Java strains, three stock strains, two recently isolated Federated Malay States strains, and two serologically atypical strains isolated by Dr. W. Fletcher in 1925 from healthy wild rats in Kuala Lumpur. A rugose type of growth was seen in all cultures except in one of the stock Institute for Medical Research strains (Jacques' rat) and in the two serologically atypical strains. A second stock Institute for Medical Research strain (Elkins) showed both mucoid and rugose characters. Fletcher has pointed out that strains after long cultivation in the laboratory become limited in their action on "sugars" to acid production in glucose. This was found to be the case with both the local and Javanese strains, except for weak acid production in arabinose and galactose which occurred after 6 to 14 days' incubation at 37°C. with two of the old Federated Malay States strains and with two of the Javanese strains.

The following is a résumé of other biochemical reactions of the group: Fairly rapid gelatin liquefaction, either stratiform by the seventh day, or napiform later becoming stratiform by the fourteenth day, occurred with all except the two serologically atypical strains, which failed to show liquefaction within 14 days. With all strains, the catalase reaction and methylene blue reduction were positive and H_2S production and the Voges Proskauer reaction entirely negative. Ammonia production was marked with all except the serologically atypical strains, which, after six days' incubation, showed no reaction with Nessler's reagent. All strains were motile except one, when recently isolated from a human lung abscess. The first cultures were made on the 7th of November and motility did not develop until about a fortnight later after at least five sub-cultures through peptone water. The serologically atypical cultures (but none of the others up to 14 days), produced acid in xylose in six days, though no acid was produced by them in arabinose and galactose in 14 days. There were marked differences between the strains in their action on litmus milk. The typical reactions described by Fletcher were seen with all strains except the two serologically atypical ones. With these, primary alkalinity persisted for at least nine days, but, after an interval of weeks, the appearance of the cultures was indistinguishable from that of other strains after incubation for from five to seven days.

Serologically, all the typical strains, including one isolated from a domestic pig, were agglutinated ("O" type agglutination) by stock *B. whitmori* immune (Rajaviah and Elkins) sera. The atypical strains showed weak "H" type agglutination, but no trace of "O", in the first two dilutions—1/50 and 1/125. Other strains gave no "H" type agglutination.

EOSINOPHILIA IN THE CEREBRO-SPINAL FLUID.

During routine examination of specimens of cerebro-spinal fluid, only three cases with marked eosinophilia have been seen. From all three *B. whitmori* has been isolated.

Case No. 1, a Tamil, aged 42, had fever for about 13 days. Clinically, there was paralysis of the bladder and intestines, semi-consciousness, and irritability. The knee jerks and superficial reflexes were absent, and movement was much impaired. The cerebro-spinal fluid, which proved negative on culture, was slightly turbid. Cells numbered 325 per c.mm. and the centrifuge deposit showed a very high proportion of eosinophil leucocytes. The globulin was increased, but sugar was normal. The patient died four days later, and *B. whitmori* was isolated from material obtained from autopsy.

Case No. 2, a Chinese, aged 24, was admitted to hospital with a history of five days illness and with signs of meningitis. There was semi-consciousness and retention of urine. No cultures were made of the cerebro-spinal fluid, which was heavily contaminated, but showed a marked increase in the eosinophil leucocytes. The patient died on the evening of the sixth day, and multiple abscesses of skin, lungs, and liver were found, from which *B. whitmori* was isolated. The meninges were congested.

Case No. 3, a male Chinese, aged five months, was brought to hospital on the fifth day of illness with convulsions and fever, the temperature ranging between 100.4°F. and 104°F. On the eighth day signs of meningitis appeared, and the cerebro-spinal fluid was found to be turbid. Direct smears revealed a marked predominance of eosinophil cells, and Gram-negative bacilli, some of which were intracellular. *B. whitmori* was isolated from this specimen, and also from the purulent meninges found during examination after death on the ninth day.

B. GOMEZI, MACKIE.

At the request of Colonel Mackie, I.M.S., strains Gomez II and Scott II of *B. gomezi*, isolated from cases of sprue and forwarded to this Institute, have been investigated in regard to possible relationship with *B. whitmori*. Dr. P. H. Martin found, on plating, that the Scott strain consisted of rough, sticky, yellowish colonies which could be picked up whole by a platinum loop. Satisfactory emulsion of the strain in saline was impossible, for, after a few hours, a sticky stringy mass of bacteria separated to the bottom of the tube leaving the supernatant fluid almost clear. As regards the Gomez II strain, about 90 per cent. of the colonies obtained by plating were smooth. The rough colonies were indistinguishable from those

of the Scott strain and the appearance of the smooth colonies agreed with the description by Mackie and Goré: they were almost hemispherical, pale greenish-yellow in colour, smooth, viscous, and easy to emulsify in saline. The smooth colonies developed more slowly than the rough; a good growth on agar was obtained within 48 hours from rough colonies of both the Gomez and Scott strains, but Gomez smooth cultures were scarcely visible until after that interval.

Both organisms appeared to be vibrios. The smooth Gomez strain was cultured in peptone water, acid peptone water, alkaline peptone water, and glucose peptone water at 37°C. and at 23°C. No motile forms were found although daily observations were continued for some time. Later, daily sub-cultures in peptone water at 37°C. were recommenced and, at the fifth sub-culture, the Gomez smooth culture gave motile forms, and, a few days later, the rough cultures also. Motility was great and the movement violent, with frequent changes of direction. The motility has persisted up to the end of the year. Attempts have been made to obtain, by repeated plating, a smooth form of the Scott strain but they have been fruitless. It has also been impossible to modify the rough culture in such a way as to produce a satisfactory saline emulsion.

When the cultures were first received, no action on glucose or maltose was obtained, but, more recently, a trace of acid has been produced in both these sugars after an interval of 7 to 14 days. No rugose growth on glycerine agar, and no liquefaction of gelatin, which are characteristics of *B. whitmori*, were obtained with the Gomez strain. Serologically, the serum of a rabbit immunised against the smooth Gomez strain failed to agglutinate *B. whitmori* and emulsions of the Gomez culture were not agglutinated by *B. whitmori* immune rabbit serum.

CHROMOBACTERIUM VIOLACEUM.

Strains of this organism from three sources have been isolated by Dr. P. H. Martin during the year. The first was from an autopsy performed by Dr. C. Russell Amies on a European, who died in a hectic fever that had continued for some days. The material for culture was obtained from multiple small liver abscesses, the pus from which had a faintly greenish tinge. From all three tubes inoculated a violet-producing Gram-negative bacillus was obtained in pure culture.

A second strain was isolated from a specimen of urine passed by a patient, suffering from heart failure with ascites and an enlarged liver, who also complained of painful joints. The course of the illness was almost afebrile. He died of cardiac failure, but no post-mortem examination could be obtained. From a second ante-mortem specimen of urine *C. violaceum* was not isolated. On the other hand the patient's serum agglutinated the organism isolated on the first occasion to a titre of 1/280 "O" and 1/680 "H", while a control serum gave negative results. In addition to these strains, several cultures have been obtained from various water samples.

Non-Pigment Forming Variants of *C. violaceum*.

The stock strain "Huah Chee" of *C. violaceum* (I.M.R. Annual Report, 1927), the strain isolated from urine as described above, and a strain from a local water supply, have been found to produce colonies which fail to form the usual violet pigment. These non-pigmented colonies have, on sub-culture, uniformly produced growth of a slightly yellow tinge on ordinary solid medium. The non-pigmented variants are readily distinguishable from the violet-producing strain when the latter are failing, through conditions of culture, to produce strong pigment. Under these conditions the violet cultures have a weak, faded appearance. The non-pigmented variant is seen in sharp contrast when cultures are made side by side on the same culture medium.

Investigation of Various Cultures of *C. violaceum*.

All strains were found to be Gram-negative and motile, except the chromogenic and non-chromogenic varieties of "Huah Chee", both of which, however, regained motility after successive sub-cultures in fluid media. Confirmation of absence of motility early this year is provided by the finding that a rabbit, immunised against the culture before the appearance of the non-chromogenic variant, produced "O" agglutinins. The biochemical findings showed no change from those obtained by Dr. J. E. Lesslar and described in the annual report for 1927. Complete tests were not carried out but ammonia production and the catalase reaction were added to the list of positive findings, while methylene blue reduction and H_2S production were found to be negative. The strain isolated from the liver abscess case was injected intra-peritoneally and sub-cutaneously into two guinea-pigs. The consequent local reactions were slight. Both animals, apparently in good health, were sacrificed three weeks after inoculation and no lesions were seen at the post-mortem examinations.

Serological findings have not been carried far as the work was interrupted by the death, from intercurrent infection, of several of the immunised rabbits. The four sera produced did not show uniform agglutination, either of "H" or "O" type, when tested against the four strains used for immunisation.

VARIOLA.

Serological Diagnosis.

Outbreaks of smallpox not infrequently occur in this country. The population is reasonably well vaccinated, and consequently modified cases are met with which are difficult to recognise. Immediate diagnosis is most desirable but often impossible on clinical grounds, and the assistance available from the laboratory has been disappointing. In the past, a series of Paul's tests (the inoculation by superficial scarification of material from a lesion of a suspected case into the cornea of a rabbit) has been undertaken, but positive results were obtained in only three instances with material from nine modified and mild cases of smallpox.

The reaction which has developed from Gordon's researches, when applied by the technique devised by Craigie and Tullock, seemed to offer better promise, and serum, prepared by the inoculation of rabbits with "lapine," has given definite and specific reactions with specimens from about a dozen cases of smallpox. Satisfactory material cannot be obtained until a case has reached the "crusting" stage, and results are not available until 48 hours after the collection of specimens. The test appears to be a useful confirmatory one for doubtful cases but the delay before a report can be furnished is a serious drawback. A large percentage of rabbits died of anaphylaxis during immunisation, and the production of a high titre serum was found to be no easy matter.

THE DETERIORATION OF LYMPH.

The investigation of deterioration at room temperature of lymph has been continued by the courtesy of Dr. (Mrs.) M. J. Were at the Infant Welfare Centre, Kuala Lumpur. The figures obtained with different batches, after storage at room temperature for various intervals, are shown in the following table:

TABLE XL.

BUE Bateh No.	Days at room temperature.		Insertions made.	Insertions inspected.	No. perfect.	No. modified.	No. failed.	Month in which lymph was removed from cold storage.	Dilution of pulp expressed as a fraction.	Intra-dermal test (average of two rabbits).	
										Potency as a fraction of dilution given in previous column (unless otherwise stated).	Date of test.
B11/30	0	37	22	22	0	0	0	May ...	1/4½	... 1/5,000 (diluted to 1/18 with saline before insertion)	22-1-31
"	1	37	22	19	3	0	0	May ...	"		
"	2	15	3	3	0	0	0	January ...	1/6		
"	2	15	3	3	0	0	0	January ...	"		
B13/30	0	130	69	67	2	0	0	Jan. and May	"	1/7,500 (diluted to 1/18 with normal saline before insertion)	22-1-31
"	1	12	10	10	0	0	0	February ...	1/4½		
"	1	12	10	6	1	3	3	February ..	"		
"	1	34	13	7	5	1	1	May ...	1/6	1/6,000 (diluted to 1/18 with normal saline before insertion)	22-1-31
B14/30	2	8	6	6	0	0	0	January ...	"		
"	2	8	6	6	0	0	0	January ...	"		

TABLE XL—(cont.)

Batch No.	Days at room temperature.	Insertions made.	Insertions inspected.	No. perfect.	No. modified.	No. failed.	Month in which lymph was removed from cold storage.	Dilution of pulp expressed as a fraction.	Intra-dermal test (average of two rabbits).	
									Potency as a fraction of dilution given in previous column (unless otherwise stated).	Date of test.
B16/30	1	10	6	5	0	1	February ...	1/6	1/11,000 (diluted to 1/18 with normal saline before insertion)	22-1-31
"	1	10	6	2	0	4	February ...	"		
B18/30	0	133	79	78	1	0	Various ...	1/4	1/16,000 ...	22-4-31
"	1	85	49	48	1	0	May and July ...	"		
"	2	16	12	12	0	0	March ...	"		
"	3	16	8	7	0	1	March ...	"		
"	4	14	10	8	0	2	March ...	"	1/12,000	4-8-31
B22-23/30	0	59	31	31	0	0	May and June ...	"	1/16,000	8-1-31
"	1	15	13	13	0	0	June ...	"		
"	2	12	4	4	0	0	May ...	"		
"	3	16	5	5	0	0	May ...	"		
"	4	16	9	9	0	0	May ...	"		
"	6	9	5	1	4	0	June ...	"	1/6,000	26-8-31
B24-25/30	0	170	105	102	2	1	Various ...	"	1/16,000	8-1-31
"	1	41	37	35	2	0	July ...	"		
"	3	53	26	25	0	1	March ...	"		
"	4	19	7	7	0	0	March ...	"		
"	5	106	66	58	5	3	October ...	"		
B24-27/30	0	170	105	102	2	1	Various ...	"	1/16,000	8-1-31
"	1	41	37	35	2	0	July ...	"		
"	3	53	26	25	0	1	March ...	"		
"	4	19	7	7	0	0	March ...	"		
"	5	106	66	58	5	3	October ...	"		
B26-27/30	0	160	115	115	0	0	Various ...	"	1/16,000	8-1-31
"	1	80	60	59	1	0	May and July ...	"	1/15,000	22-4-31
"	7	69	51	50	0	1	October ...	"	1/16,000	26-8-31
B28/30	0	178	101	101	0	0	Various ...	"	1/16,000	14-1-31
"	1	80	43	43	0	0	April and August ...	"	1/16,000	14-4-31
"	7	42	26	26	0	0	October ...	"	1/16,000	26-8-31
B29/30	0	52	22	22	0	0	February ...	1/3	1/9,000	19-1-31
"	1	13	3	2	0	1	February ...	"	1/4	
"	2	26	16	15	1	0	February ...	"		
"	0	189	97	97	0	0	Various ...	"		
"	1	43	30	28	2	0	June ...	"		
"	2	56	7	7	0	0	April ...	"		
"	3	31	11	11	0	0	April ...	"		

TABLE XL—(cont.)

Batch No.	Days at room temperature.	Insertions made.	Insertions inspected.	No. perfect.	No. modified.	No. failed.	Month in which lymph was removed from cold storage.	Dilution of pulp expressed as a fraction.	Intra-dermal test (average of two rabbits).	
									Potency as a fraction of dilution given in previous column (unless otherwise stated).	Date of test.
B30/30	0	123	73	73	0	0	Various ...	1/4	1/12,000	14-1-31
"	1	31	24	24	0	0	August ...	"	1/16,000	1-9-31
"	2	32	14	14	0	0	March ...	"		
"	3	24	7	7	0	0	March ...	"		
"	7	36	28	28	0	0	November ...	"		
B31/30	0	73	44	41	3	0	May and November	"	1/14,500	16-1-31
"	2	18	8	8	0	0	May ...	"	1/10,000	1-5-31
"	7	55	36	27	8	1	November ...	"	1/12,000	1-9-31
B32/30	0	12	6	6	0	0	February ...	1/3		
"	5	12	6	4	2	0	February ...	"		
"	0	52	22	21	1	0	Various ...	1/4	1/2,500	16-1-31
"	1	71	40	33	4	3	Various ...	"	1/2,500	1-9-31
"	2	65	36	27	1	8	March and April	"	1/2,000	3-12-31
"	3	34	14	10	2	2	March ...	"		
B33/30	0	165	80	73	5	2	Various ...	"	1/12,500	16-1-31
"	1	43	20	19	1	0	August ...	"	1/14,000	14-4-31
"	2	6	1	1	0	0	March ...	"	1/16,000	1-9-31
"	3	16	9	9	0	0	March ...	"		
B34/30	0	37	29	29	0	0	August ...	"	1/16,000	1-1-31
"	7	37	29	27	1	1	August ...	"		
B35/30	0	76	47	46	0	1	Various ...	"		
"	2	10	4	3	0	1	May ...	"	1/16,000	17-1-31
"	7	52	35	24	6	5	September and December	"	1/14,000	7-9-31
B36/30	0	81	42	41	0	1	Various ...	"	1/10,000	17-1-31
"	1	25	12	11	1	0	April and September	"	1/4,000	7-9-31
"	2	46	20	18	1	1	April and September	"	1/2,500	3-12-31
B38/30	0	68	31	31	0	0	April and September	"		
"	2	31	7	7	0	0	April ...	"	1/16,000	17-1-31
"	6	19	12	11	0	1	April ...	"	1/14,000	7-9-31
"	7	18	12	11	1	0	September ...	"		
B1/31	0	48	36	36	0	0	June and September	"	1/14,000	1-4-31
"	2	31	25	24	0	1	June ...	"	1/14,000	29-4-31
"	4	17	11	10	0	1	September ...	"	1/6,000	3-12-31
B2/31	0	100	51	51	0	0	June and October	"	1/12,000	1-4-31
"	1	38	22	21	1	0	June ...	"	1/8,000	29-4-31
"	6	25	7	7	0	0	October ...	"	1/7,000	3-12-31
"	7	37	22	22	0	0	October ...	"		
B3/31	0	132	88	83	4	1	Various ...	1/4	1/7,000	29-4-31
"	1	70	46	40	5	1	July and August	"	1/4,500	17-7-31
"	6	26	17	15	1	1	October ...	"	1/4,500	3-12-31
"	7	36	27	23	1	3	October ...	"		

With the various batches of lymph, kept at room temperature for periods of from 4 to 7 days, modified reactions accounted for 7.6 per cent., and failures for 4.3 per cent. among 393 insertions. These figures compare with 1.2 per cent. modified reactions and 0.35 per cent. failures among 836 insertions made with the same batches of lymph immediately after withdrawal from cold storage.

"NEUTRALIZATION" OF LYMPH.

During the year complaints were received from the Northern Settlement that lymph did not appear to be fully potent. It was found that tubes were being stored in a household ice-box which, at intervals during the twenty-four hours, contained little, if any, ice. Sample tubes were taken from the ice-box and the potency, which on despatch from the Institute had been 1/6,000, was found to have fallen to 1/100 only. Cases of smallpox continued to occur in the district, and even with fresh lymph, the success rate for vaccination was low. The local Malays were said to be neutralising the lymph as soon as possible after insertion, by the application of a mixture of the juice of limes and common salt.

The action of lime juice saturated with sodium chloride has been investigated at the Infant Welfare Centre, Kuala Lumpur. Small discs of lint were saturated with the juice and applied firmly by means of adhesive plaster to an insertion not less than 10 minutes after it had been made. Control insertions with the same lymph were made above this "experimental" insertion. It has been found that in 47 cases the application resulted in a reduction in the percentage of perfect "takes" from 86 to 28, and no less than 45 per cent. of the insertions failed to "take".

Where this method of evasion of vaccination is likely to be practised, it is most desirable that vaccinators should keep all the vaccinated cases under observation for a considerable interval of time.

EXTRACT OF RICE POLISHINGS.

It is of interest that the Permanent Commission on Biological Standardization, Health Organisation, League of Nations, in their recent report advocate the use as a tentative standard of a vitamin B extract, prepared by the technique described by Jansen and Donath. An extract of rice polishings, for the prophylaxis and treatment of beri-beri, prepared by that method has been issued from the Institute for the last two years. A considerable amount of experimental work on pigeons has been undertaken by Dr. I. A. Simpson, and he has found that a sample of the first batch, prepared in January, 1930, when re-tested in December, 1931 (i.e., after an interval of nearly 24 months), showed no decrease in activity. For batches prepared during the present year, the average pigeon curative day dose, i.e., $\frac{\text{the minimum dose required to cure a polyneuritic pigeon}}{\text{duration of cure in days}}$

has been 14 milligrammes. This figure compares favourably with the standard suggested by the Permanent Commission on Biological Standardisation, i.e., 20 to 30 milligrammes for a pigeon of about 300 grammes in weight.

While it appears very probable that this adsorption product of the anti-neuritic vitamin does exert a beneficial effect on cases of beri-beri, complete records of a large series of carefully controlled cases are not yet available. It is hoped to publish in due course the results of an investigation in this connection.

THE BLOOD GROUPING AMONG THE SAKAI.

In the course of other investigations, an opportunity was taken by Dr. R. Green to ascertain the proportions of the four blood groups among Sakai. It was thought that the results would be of ethnological interest, for this factor serves as a criterion of racial relationships. In order that the results should be as representative as possible, small tribes were examined in various districts of Pahang, Perak and Selangor, though it is not impossible that there has been minor intrusion of Malay blood, resulting in some modification of the original blood groupings.

The high percentage belonging to group "O" and the low percentage of group "A" are noteworthy. In the following table, comparative figures for Javanese, Sumatrans and Singapore Malays are included:

TABLE XLI.

BLOOD GROUPS OF SAKAI.

Investigators.	Race.	No. examined.	Blood group percentages.			
			O	A	B	AB
Bais and Verhoef ...	Javanese ...	1,346	39.9	25.7	29.0	5.4
„ „ ...	Sumatrans ...	546	43.7	23.0	29.0	4.0
Ando ...	Malays (Singapore)	100	39	33	21	7
Green ...	Sakai (F.M.S.) ...	165	54	10	31	5

FILARIASIS.

From time to time reference has been made in these reports to the finding of microfilariae in the blood of dwellers in Malaya. For instance, in the Annual Report for 1904, cases are cited, and infection with *Filaria bancrofti* diagnosed. It was stated in that report that microfilariae were occasionally found in the blood of Tamils, Chinese and Malays, but that the incidence of elephantiasis and filarial lymphangitis was comparatively low being, at that time, seen once in about 6,000 admissions to the Selangor hospitals. Reference was again made to the subject in the Annual Report for the Medical Department, Federated Malay States, for 1930. It was there pointed out that an endemic centre of filarial infection existed on the lower reaches of the

Perak river. At Teluk Anson no less than 13 cases of filariasis were diagnosed during that year, but microfilariae were seen in the blood of one case only.

In connection with the various films examined by the Malaria Research Division, the blood for which is usually taken in the daytime, about 1 in every 5,000 specimens has been found to contain microfilariae. Among one group of 12 Sakai living in the Puchong district of Selangor, no less than 3, or 25 per cent., were found to harbour these parasites.

BACTERIOLOGICAL EXAMINATION OF WATERS.

It is generally accepted that in the tropics the gas line in lactose cultures at 37°C. gives an exaggerated idea of the danger of recent pollution. Even when a reliable test for indol production is added, interpretation is probably still too severe for such organisms as *B. grunthali* and *B. cloacae*, commonly found in local waters, have been reported to be resistant to the process of natural purification.

Eijkman's test has been the subject of adverse criticism by Brown and Skinner (1930) from Minneapolis; but, in view of Taylor and Goyle's (1931) publication from Rangoon, it was decided to investigate its possibilities. Accordingly, Dr. P. H. Martin has examined a large number of water specimens from known sources by the three tests, i.e., the gas line in lactose-bile-salt-peptone cultures, the lactose plus indol index, and the gas line in the Eijkman test.

The Routine Test for Indol.

It appeared possible that the indol test, as now applied for routine specimens (*see* routine examinations), might not give a true indication of the presence of indol-forming organisms on account of the possible inhibitory effect of a sugar (lactose) in the medium and lack of sensitivity to indol of the modified Goré's test. Peptone water tubes were accordingly inoculated with single loopfuls of culture from those lactose-bile-salt tubes, that showed gas after 24 hours incubation at 37°C. These peptone water cultures, after 24 hours incubation at 37°C., were tested for indol, after ether extraction, by the addition of Ehrlich's reagent to form a ring with the ether above the peptone water. No persulphate was used. The indol line was found at the same volume of water by the two techniques in 40 of 50 samples. In two instances, the modified Goré test was positive in smaller volumes than the secondary peptone water cultures, while in eight samples, the secondary peptone cultures were positive in smaller volumes than the modified Goré test.

The Gas Line in Primary-Lactose-Bile-Salt-Peptide Cultures.

Seventy-seven cultures, isolated from lactose-bile-salt and glucose (Eijkman) tubes, have been examined and classified according to the grouping suggested by Ruckhoft, Kallas, Chinn, and Coulter (1931).

TABLE XLII.

GROUPING OF LACTOSE AND GLUCOSE FERMENTING ORGANISMS.

		"Coli"		"Inter- mediate"		"Aerogenes or extran- eous"	
		Groups.		Groups.		Groups.	
		1	2	3	4	9	10
Group reactions	Indol	—	+	+	—	—	—
	Voges Proskauer	—	—	—	—	+	—
	Methyl red ...	+	+	+	+	—	—
	Citrate	—	—	+	+	+	+
Numbers of colonies isolated in accordance with group reactions	Lactose 37°C. (52)	1	10	4	11	18	8
	Glucose 46°C. (25)	1	12	3	4	3	2

The Eijkman Test.

The Eijkman test is not perfect for the discrimination between the "Coli" and the "Aerogenes" groups. Brown and Skinner (1930) are confirmed by Taylor and Goyle (1931) in finding that it may fail both in the detection of *B. coli* and in the elimination of *B. aerogenes*. Some evidence in this connection has been obtained during the past six months. From Table No. XLII it is seen that of 25 cultures isolated from glucose positive tubes, 13 gave reactions, according to Ruckhoft's grouping, of the "Coli" group. This proportion is much higher than the 11 out of 52 cultures isolated from the lactose positive tubes and giving the same reactions. Twenty-eight cultures were recovered from positive lactose tubes, with corresponding glucose tubes negative. In no instance was *B. coli communis* found. Eight cultures were indol-forming, and the organisms fell into the following groups: *B. neapolitanus* (3); *B. grunthali* (2); and *B. cloacae* (3). Bacilli, having the reactions of *B. lactis aerogenes*, were identified 12 times. The remaining eight cultures formed no indol but utilised citrate: they were not readily identifiable.

The above summary is based on findings regarding morphology, gram-staining, motility, Voges Proskauer, methyl red, citrate and indol tests, and the fermentation of lactose, glucose, saccharose and dulcete. The numbers are small but the results indicate that the Eijkman test, while failing to react to some of the more resistant "coliform" organisms, was not proved to have missed "coliform" organisms of the susceptible group.

In order to obtain data relative to the production of gas within 24 hours in glucose at 46°C. by organisms freshly isolated from human faeces, specimens from three Malays, four Chinese, and three Tamils, were plated on eosin-methylene-blue medium. On each of the ten plates an area was selected which appeared to show well isolated colonies and colonies representative of all those occurring over the plate. From each of these areas 10 colonies were inoculated into glucose tubes which were then incubated at 46°C. for 24 hours. Only 13 of the 100 tubes failed to show gas, and of them, two were found to be streptococci. It is realised that the inoculum was massive in comparison with the number of intestinal organisms inoculated in a routine water test.

The dying out of many "coliform" organisms within 48 hours in glucose at 46°C. has been confirmed with strains of *B. coli communis*, *B. coli communior*, *B. immobile*, and *B. neapolitanus*. Although good multiplication and gas production occurred during the first 24 hours with all four organisms, only the last species showed a few living organisms after 48 hours. Of the non "coliform" organisms, isolated from glucose tubes of routine water examinations, several have been re-inoculated in pure culture into glucose tubes for sub-culture at 46°C. Judged by the turbidity, multiplication was good during the first 24 hours, but in several instances gas production was delayed until the second day and the quantity was markedly less than that usually found in glucose tubes inoculated with "coliform" organisms. Organisms of the "Aerogenes" group are thus not necessarily killed by 24 hours incubation at 46°C. It has been shown that they can multiply under such conditions, but the amount of gas produced is small and production may be delayed until after 24 hours.

Results of Tests on Various Waters.

The three tests, lactose-bile-salt gas line at 37°C.; "lactose plus indol plus" index, and glucose gas line at 46° have been applied to a number of raw and treated waters from various supplies. For purposes of comparison an attempt has been made to indicate the relative sensitivity of the tests by the average minimum volume of water giving a positive result. Positive results in 100 c.cms. and 25 c.cms. have been taken as such, but, to the volume of the negative findings, 10 per cent. has been arbitrarily added, i.e., when a sample has given negative results in 100 or in 25 c.cms. the volumes have been taken as 110 and 27.5 c.cms., respectively, in calculating the averages.

As regards the counts per c.cm. on agar after 24 hours at 37°C., a few very abnormally large ones have been omitted from the averages. For each source of water three lines are used to record the actual volumes in which the tests (24 hours) were positive. "L" indicates gas in lactose-bile-salt cultures at 37°C.; "I", positive indol in positive lactose-bile-salt tubes; and "G", gas in glucose at 46°C.

The results obtained with raw untreated waters and well waters are included in Table XLIII; with waters after slow sand filtration in Table XLIV, and results after slow sand filtration followed by chlorination, or by mechanical filtration with or without subsequent chlorination, are recorded in Table XLV.

TABLE XLIII.

Untreated waters and surface wells.	Total.	Test.	Number of samples.					Average volume positive (c.cms.).	Average 24-hour count on agar at 37°C. per c.cm.
			Negative.	Positive.					
				10 c.cms.	10 c.cms.	1 c.cm.	0.1 c.cm.	0.01 c.cm.	
Bahau— Sungei Serting	5	{ L I G	{	{	{ ... 1 2	{ 5 4 3	{	{ 0.1 0.3 0.5	1,249
Gemas	6	{ L I G	{ ... 1 ...	{	{ ... 2 1	{ 6 3 5	{	{ 0.1 2.2 0.3	
Kepong	7	{ L I G	{	{ ... 2 ...	{ ... 1 2	{ 7 4 5	{	{ 0.1 3.0 0.4		220
Kuala Kubu Bahru — Impounding Reservoir ...	1	{ L I G	{	{	{	{ 1 1 1	{	{	162
Kuala Lumpur— Intake Works, Ampang ...	23	{ L I G	{ ... 2 ...	{ ... 2 ...	{ ... 11 7	{ 23 8 15	{	{ 0.1 2.3 0.8	163
Impounding Reservoir, Ampang	19	{ L I G	{ ... 1 2	{ ... 2 3	{ ... 8 10	{ 19 8 4	{	{ 0.1 2.1 3.3	129
Kuala Sleh	24	{ L I G	{ ... 4 ...	{ ... 1 ...	{ ... 6 10	{ 24 13 14	{	{ 0.1 2.6 0.5	213
Serdang— Impounding Reservoir ...	5	{ L I G	{	{	{ ... 2 2	{ 5 3 3	{	{ 0.1 0.5 0.5	426
Sungei Buloh	7	{ L I G	{	{	{ 2	{ 7 7 5	{	{ 0.1 0.1 0.4	452
Sungei Langat	1	{ L I G	{ ... 1 ...	{	{ 1	{	{ 1	{	1,180
Wells— Kepong	1	{ L I G	{ ... 1 1	{	{	{	{	{	5
Pedas	1	{ L I G	{	{	{	{ 1 1 ...	{	{	5,000
Petaling	1	{ L I G	{	{	{ ... 1 ...	{ 1	{	{	2,250
Sungei Besi	1	{ L I G	{	{ ... 1 ...	{ ... 1 ...	{	{	{	560
Ulu Selangor	1	{ L I G	{	{	{	{ 1 1 1	{	{	5,000
Estate No. 16— Dammed Stream	1	{ L I G	{	{	{ ... 1 ...	{ 1	{	{	220
Cement Tank	1	{ L I G	{	{	{	{ 1 1 1	{	{	127

TABLE XLIV.

Treated waters. Slow sand filtration only.	Total.	Test.	Number of samples.						Average volume posi- tive (c.cms.).	Average 24-hour count on agar at 37°C. per c.cm.
			Nega- tive.	Positive.						
				25 c.cms.	25 c.cms.	10 c.cms.	5 c.cms.	1 c.cm.	0.1 c.cm.	
Kepong 	7	{ L	2	1	3	1	16.4	79
		{ I	2	2	2	1	...	...	18.5
		{ G	4	3	...	...	...	...	26.4
Kuala Lumpur— Intake Works, Ampang, Clear Water Well ...	23	{ L	8	14	1	2.3	95
		{ I	4	2	2	6	9	...	9.5	
		{ G	1	..	4	4	13	1	4.4	
Do. “ X ” ...	13	{ L	5	7	1	2.5	72
		{ I	4	1	3	2	3	...	13.7	
		{ G	1	...	4	2	5	1	6.4	
Impounding Reservoir, Ampang, Clear Water Well 	18	{ L	...	2	10	4	2	...	9.6	96
		{ I	1	5	6	4	2	...	13.0	
		{ G	7	3	6	1	1	...	18.5	
Kuala Sleh, Clear Water Well 	24	{ L	...	1	16	7	8.0	65
		{ I	4	4	12	4	...	...	14.5
		{ G	2	13	6	3	...	...	19.0
Standpipes— Sanitary Board Office	2	{ L	2	10.0	40
		{ I	...	1	1	...	...	...	17.5
		{ G	1	...	...	1	...	...	16.3
Residency 	23	{ L	...	4	16	1	2	...	11.6	163
		{ I	1	9	11	1	1	...	16.0	
		{ G	7	12	1	1	2	...	22.1	
Bungsar Road ...	23	{ L	...	3	8	9	3	...	8.8	83
		{ I	2	6	9	4	2	...	13.8	
		{ G	7	6	6	2	2	...	18.0	
Sungei Buloh 	7	{ L	...	1	...	3	3	...	6.0	79
		{ I	...	2	1	3	1	...	10.0	
		{ G	...	...	2	3	2	...	5.3

TABLE XLV.

Treated waters. Sand filters and chlorination (varying dosage), or mechanical filters with or without subsequent chlorination.	Total.	Test.	Number of samples.							Average volume positive.	Average 24-hour count on agar at 37°C. per 1 c.cm.
			Nega- tive.		Positive.						
			100 c.cms.	25 c.cms.	100 c.cms.	25 c.cms.	10 c.cms.	5 c.cms.	1 c.cm.		
Bahau— Filter House	5	{ L I G	... ... ...	5 ... 5	... ... ...	... ... ...	... ... ...	... ... ...	... ... ...	3	
Public Standpipe	4	{ L I G	... ... ...	1 ... 1	... ... ...	2 ... 2	... ... ...	1 ... 1	19.6 20.6 19.6		48
Gemas— Filter House	6	{ L I G	5 ... 6	1	27.0 27.5 26.6			2
Public Standpipe	6	{ L I G	... ... ...	4 ... 5	... ... ...	2 ... 1	... ... ...	... ... ...	21.7 27.1 26.6	8	
Kuala Lumpur Supply (chlorinated)— “ Y ”	12	{ L I G	8 ... 9	... ... ...	... 1 ...	2 1 1	2 1 1	... ... ...	79.2 93.8 93.8		17
“ Z ”	23	{ L I G	19 ... 20	3 ... 2	1 ... 1	104.3 104.8 98.0			24
“ W ”	9	{ L I G	1 ... 2	... ... ...	5 ... 4	2 ... 2	1 ... 1	... ... ...	74.4 75.5 98.8	44	
Weld Hill Inlet	23	{ L I G	7 ... 15	1 ... 4	3 ... 1	4 ... 1	7 ... 1	1 ... 1	55.3 74.6 82.4		18
Serdang— Mechanical filters. With or without chlorination	6	{ L I G	2 ... 3	1 ... 3	1	1 ... 1	16.0 26.2 23.8			80

Untreated Waters and Surface Well Waters.

The figures for these waters are so bad that they do not form a satisfactory basis for comparison between the tests. In one instance, however, a comparison is instructive. The water for Kuala Lumpur is obtained from three rather similar catchment areas. At the Ampang Intake Works and at Kuala Sleh there is little storage, and the Eijkman readings averaged 0.8 and 0.5 c.cms. respectively. On the other hand, the Impounding Reservoir, Ampang, is fed by jungle streams from a similar catchment area, fairly free from human but not from wild animal occupation. In this instance storage (approximately 80 days) is maintained. For water from this source, the average Eijkman figure was 3.3 c.cms.

The average lactose and indol figures from the three catchment areas are remarkably similar *inter se*.

Water treated by Slow Sand Filtration.

The Eijkman test appears to give a somewhat better view of the Kuala Lumpur waters (excluding samples from the clear water well, Ampang Intake Works) than the lactose and indol tests. This result was to be anticipated from a consideration of

local conditions, but the finding does not indicate that dangerous pollution would necessarily have been dealt with satisfactorily. The Eijkman readings are not sufficiently high for safety, and the isolation of *B. coli communis* from a glucose test on Kuala Lumpur water may be mentioned to support that statement.

Chlorinated Waters.

The samples of chlorinated water from the Kuala Lumpur supplies are taken along a single pipe line some seven miles in length. Treatment prior to chlorination (Intake Works, Ampang), is by slow sand filtration. The position of points "W", "Y" and "Z" (*see table*) are as follows: "Y" is about 10 yards below, "Z" about 660 yards below, and "W" about $4\frac{1}{2}$ miles below the chlorination point, while the distance between chlorination point at the Intake Works and the Weld Hill Service Reservoir Inlet is about seven miles. The quantity of chlorine has been varied during the period by the Chief Chemist, Mr. R. W. Blair, owing to experimentation to determine optimum dosage.

Waters treated by Mechanical Filtration, with, or without, Subsequent Chlorination.

The fact that the maximum volume tested has not exceeded 25 c.cms. has tended to nullify any differences that might otherwise have been found between the results of the three tests.

A Comparison between Tests on Individual Water Samples.

When the double gas line for lactose and the glucose ($37^{\circ}\text{C}.$) was introduced by Clemesha (1912), he stressed the proximation of the two gas lines, as an indication of recent pollution. The approximation between the lactose gas line ($37^{\circ}\text{C}.$) and the Eijkman test ($46^{\circ}\text{C}.$) has not the same significance; but where the Eijkman test has been positive in a smaller volume than the lactose test, most samples have been distinctly suspicious or bad. The average agar count per c.cm. on 12 samples, where the glucose was positive in 1/10 the volume positive in the lactose test, has been 139. In four samples of raw water and one from a shallow well, the Eijkman test was positive in 1/100 c.cm. but the lactose gas line was not below 1/10th c.cm. Under certain conditions the Eijkman test has thus been found even more sensitive than the lactose test. With 187 consecutive samples of waters of better quality, the average volume to give positive Eijkman results was eight times greater than the average volume producing gas in lactose at $37^{\circ}\text{C}.$

To sum up, the lactose gas line is too stringent a test in tropical practice in view of the large proportion of organisms of the "Aerogenes" and intermediate types. The mass indol test (modified Goré's technique) has not been found uniformly reliable, and the presence of organisms of the Cloacae and Grunthali groups tend to make the indol line too low. The gas line with the Eijkman test has been found definitely higher than that with lactose. In some instances, however, this test failed to detect "coliform" organisms of the Neapolitanus type. Gas production by some of the "Aerogenes" group occurred, but only in small

quantity within 24 hours. In cases of poor quality water, the Eijkman test was equal, and, in some cases, superior in reliability to the lactose test; it also showed the definite effect of impounding when both the lactose and the "lactose plus, indol plus" tests failed.

A Possible Standard for the Eijkman Test.

Taylor and Goyle, as the result of their work in Rangoon, have suggested as a standard for the tropics a negative Eijkman test with quantities less than 50 c.cs. of surface or well waters. In the Federation, samples from chlorinated or mechanically filtered supplies are just above that standard, but the waters treated by slow sand filtration are very definitely below it.

CATADYN STERILIZING BOTTLE.

The efficiency of the Catadyn sterilizing bottle has been investigated. This bottle contains a number of beads that are said to be of a new and highly active form of silver. Minute quantities of silver in the form of ions pass into solution when the bottle is filled, and destroy any bacteria which may have been contained in the water. The action of the bottle has been found very effective. Filtered river water has been employed, and to this, *B. coli*, *B. dysenteriae* (Flexner), *V. cholerae* and *B. typhosus* (stock strains) have at various times been added. With each emulsion the action has been such that the water has become sterile within 12 hours.

TABLE XLVI.

STERILIZATION BY THE CATADYN BOTTLE.

(Eight hundred c.cms. of filtered (sterile) river water were used for each test. Cultures were made at intervals in agar. The following figures represent the number of colonies after 24 hours' incubation at 37°C.)

No. of hours interval between inoculation and culture.	<i>V. cholerae</i> . 600,000 organisms per c.cm.								<i>B. dysenteriae</i> (Flexner). 600,000 organisms per c.cm.							
	c.cms.								c.cms.							
	1	1/10	1/100	1/1,000	1/10,000	1/100,000	1/1,000,000	1/10,000,000	1	1/10	1/100	1/1,000	1/10,000	1/100,000	1/1,000,000	1/10,000,000
0	...	...	...	217	27	1	1	0	...	...	...	304	65	5	1	0
1	...	148	21	2	0	0	0	0	...	...	...	83	2	1	0	0
2	1	1	0	0	0	0	0		...	304	38	1	0	0	0	
3	0	0	0	0	0	0			...	100	15	0	1	0		
4	0	0	0	0	0				274	86	17	3	0			
8	0	0	0	0					16	2	1	0				
12	0	0	0						0	0	0					
<i>B. typhosus</i> . 600,000 organisms per c.cm.								<i>B. coli</i> . 2,000,000 organisms per c.cm.								
0	...	...	...	270	75	6	0	0	...	...	...	542	296	12	3	1
1	...	...	320	68	4	0	0		...	...	259	30	3	2	0	
2	...	208	40	8	1	0	0		360	207	32	3	1	0	0	
3	180	19	3	1	0	0			216	11	2	1	0	0		
4	34	8	0	0	0				131	10	1	0	0			
8	7	0	0	0					0	0	0	0				
12	0	0	0						0	0	0					

With the usual type of bottle there is a serious fault in construction. It is filled from the top and the contaminated water passed through a perforated plate into a large container, which houses the silver beads. Drops of water are likely to collect on and below this perforated plate and bacteria in these drops would not be exposed to the action of the silver ions. When sterilized water is poured from the bottle it passes through this plate, and in doing so, mixes with any drops of non-sterilized water. A better design would include a tap at the bottom of the bottle, through which the sterilized water could be drawn off. It is understood that the manufacturers produce such a type, which is combined with a carbon filter for the removal of suspended matter.

THE "AUTOMATIC" CLEANER.

This apparatus comprises a fitment attachable to taps, and so designed that the water in its passage strikes a perforated plate and, passing through the perforations, is filtered by a layer of sharp sand. Suspended material in the water is to some extent removed by this arrangement, but the bacterial content was not found to be greatly lowered. In one instance, the tap water agar count of 165 organisms per c.cm. compared with 156 after filtration, and in another, the counts were 260 before and 240 after passage through the filter.

TRYPSOGEN IN DIABETES MELLITUS.

A supply of Trypsogen has been received from the manufacturers, who claim that the preparation is of value in the treatment of diabetes. It has been administered by Dr. R. S. Savor to three patients, and its effect noted on their blood sugar. Two of the patients, both Asiatics, were being treated by dietetic measures, but, at their own request, insulin had not been given. To these, Trypsogen was given twice daily in the dosage recommended by the makers, on alternate weeks. Weekly blood sugar tests showed no reduction in the fasting blood sugar values or in the half-hourly readings taken during the three hours following a meal. In one instance, blood sugar was estimated after the daily administration of the drug for a week, with an additional dose half an hour prior to the administration of 50 grammes of glucose. The blood sugar values were considerably higher than parallel results obtained during the previous week, when treatment had been dietetic measures only.

The third patient, a European, had been treated with insulin for the previous twelve months. He was given a daily dose of Trypsogen as recommended during every alternate week, i.e., one week of insulin therapy, alternated with one week of insulin therapy with Trypsogen in addition. At the end of each week, the blood sugar was estimated at an interval of two and a half hours after his usual lunch, which had been prescribed for him at

the onset of treatment. No lowering of the blood sugar was noted in the periods of Trypsogen therapy, and, after three months' observation, the blood sugar level had increased sufficiently to necessitate an increase in the insulin dosage.

From these instances it would appear that the administration of Trypsogen does not reduce the blood sugar; but all three patients were in agreement that during the weeks of Trypsogen treatment they had a feeling of enhanced well being.

RHINOSPORIDIOSIS.

In view of the comparative rarity of rhinosporidiosis in this country, brief notes are given below of two cases which came under observation during the year and were diagnosed histologically by Dr. R. Lewthwaite. The first case was a Tamil male child, aged 10 years. The growth was on the left side of the nasal septum near the opening of the external nares, and had been noticed by the patient for two months prior to admission to hospital. It had enlarged progressively to reach the size of a cherry.

In the second case, the patient was also a Tamil male, 22 years of age. The growth had been present for eight months, and projected from the left ethmoidal region. Its characteristic strawberry appearance had prompted a clinical diagnosis of rhinosporidial polypus, which was confirmed. In both cases the histological picture was typical of the infection.

A DISEASE OF FOWLS.

At the commencement of the year several fowls, dead and dying of a disease which at the time was causing havoc among local poultry, were submitted for investigation by the Government Veterinary Surgeon, Selangor. No bacterial cause for the disease could be found by Dr. P. H. Martin, but bacteria-free (except for some staphylococci which appeared to be non-pathogenic) emulsions of liver and spleen, injected intra-muscularly, rendered fowls moribund on the fifth and sixth days. A Seitz filtrate of liver from these passage fowls failed to induce illness within seven days, but an unfiltered, culturally sterile emulsion of the same liver killed on the seventh day. The high mortality and the symptomatology suggested fowl-pest or pseudo-pest. The pathological findings are also compatible—small haemorrhages in the epicardium and along the alimentary tract, most marked in the cloaca. At a later date the experiments were repeated and the injection of Seitz filtrates of liver into fowls reproduced the disease.

An emulsion of liver and spleen in phenol glycerin, according to the technique described by Todd (1928), was prepared in the hope of producing a hyper-immune serum which could be forwarded to England for identification. The emulsion

has been tested as a vaccine on four fowls. It afforded no protection against injected virus, or against infection as a result of exposure to infected birds.

A second vaccine was then prepared on similar lines to those described by Kylasamaier (1931) using dilute formol-saline. Glycerine was not employed as the livers were removed immediately after death with all precautions to prevent contamination. This vaccine could not, however, be tested as the laboratory strain of virus had unfortunately died out, and the epidemic had ceased.

Symptomatology.

The natural illness has a duration of from four to six days and fowls inoculated with virulent material have, with one exception, been killed when moribund on the fifth day or have been found dead by the morning of the sixth day.

Only cocks have been used for experimental inoculation, and these have lost interest in their surroundings some 72 to 96 hours after injection of virus, and about 48 hours after the onset of fever. A short time later they squat rather than stand, and show definite respiratory embarrassment, making a low asthma-like inspiratory wheezing (sometimes also expiratory) with stretching of the neck and opening of the beak. There appears to be relatively little extra secretion to account for this condition. At the most, a teaspoonful of earth-stained mucoid fluid can be obtained from the beak when the bird is turned head downwards. Later, the wings and head droop, and the comb becomes cyanosed. Diarrhoea is usual during the last 48 hours, the faeces being white or greenish-white in colour—staining with blood has not been observed. Fever usually develops within 48 hours of infection. The morning temperature is about 109°F. and it remains between 109° and 110°F. for two days. No extreme fall of temperature in the terminal stages has been noted.

Morbid Anatomy.

Findings common to all post-mortem examinations have been sub-epithelial haemorrhages in the alimentary tract, usually throughout the intestines, but always present in the proventriculus and in the cloaca, where they are most marked. In the advanced cases, necrosis with slough formation and ulceration has been seen at the site of these haemorrhages in the intestines and cloaca. Dr. F. E. Byron, using Van Slyke's apparatus for the alkali reserve of blood, has found that the plasma of sick birds, obtained by heart puncture, will not give up any oxygen after being kept for an hour at 42°C. (Kempner, 1927). No experiments have as yet been carried out to determine whether oxygen is actually consumed by the plasma after separation. The preparation of paraffin sections from various tissues is being undertaken. No cell inclusions, comparable with Negri bodies have been found in the cells of the brain.

IV.—ROUTINE.

DIVISION OF BACTERIOLOGY.

(DR. P. H. MARTIN.)

The Preparation of Prophylactic Vaccines.

TABLE XLVII.

QUANTITIES OF VACCINES PREPARED AND ISSUED.

	Stock Jan. 1st c.cms.	Quantity prepared c.cms.	Issued c.cms.	Destroyed c.cms.	Stock Dec. 31st c.cms.
Cholera vaccine ...	46,240	30,800	3,550	35,990	37,500
Plague vaccine ...	3,750	2,000	75	1,700	3,975
T.A.B.C. vaccine ...	4,055	2,050	1,067	—	5,038
T.A.B. "Shock" vaccine ...	—	500	300	—	200
Anthrax vaccine No. 1	—	200	200	—	—
„ „ No. 2	—	200	200	—	—

Cholera Vaccine and Bacteriophage.—No cholera had occurred recently in the Federated Malay States and hence no fresh local strains were available. The bacteriophage, left by d'Herelle in 1927, was not very potent against the available laboratory cultures, but, during the year, Colonel Morrison, I.M.S., kindly supplied six strains which he was using for the preparation of bacteriophage, and a number of ampoules of combined dysentery-cholera 'phage. These six strains of vibrios have been incorporated in the later batches of cholera vaccine. Production is at the rate of three litres monthly. In February two and a half litres were issued to Penang, but otherwise the demand for this vaccine has been small. The bacteriophage, obtained by the courtesy of Colonel Morrison, has been found fully potent, and a small stock (about one litre) has been prepared and is available in bottles of 50 c.cms. capacity.

Plague Vaccine.—The stock cultures of *B. pestis* appeared to have become avirulent for rats until strain No. HG. 1480, which was received in 1928 from the Haffkine Institute, killed a rat on the third passage. The culture was recovered from the heart blood and was used for the production of a small batch of vaccine, by the technique described by de Smidt. During the year, Prof. W. A. Young kindly supplied a strain of *B. pestis*.

T. A. B. C. Vaccine.—The following strains have been employed in production :

B. typhosus; "Rawlings", "Tan Tang Kit", and "Meow Kee". All are motile, the second is in use for the routine detection of "O" agglutinins, while the third was used for that purpose in 1930.

B. paratyphosus A; "H.A. 1", and "P. K. Pillay". The first was originally obtained from the National Collection of Type Cultures; the second was isolated locally.

B. paratyphosus B; "H.B. 2", *B. aertrycke*, Schutze, Glasgow, and *B. typhosus C*, No. 90, were also originally obtained from the National Collection of Type Cultures, London.

Anthrax Vaccine.—The non-sporting strains of *B. anthracis*, obtained from Dr. Otten in 1929, have been utilised for small batches of vaccine for Kelantan. The virulence of each batch was tested on guinea-pigs and rabbits. A report on the reactions occurring in inoculated animals has been kindly supplied by the Chief Medical Officer, Kelantan. Following the inoculation of 591 adult animals with No. 1 vaccine, 58 were unfit for work for two or three days, while three had severe local and general reactions and were unfit for five days. After the vaccination of 531 with vaccine No. 2, 5 had severe local and general reactions and were unfit for work for five days. Twenty-five calves were also vaccinated in September. Five were said to have died within a fortnight after the second injection, but the illnesses and deaths were not reported until a later routine visit by a Veterinary Inspector who could not obtain any reliable description of the condition during illness or after death. Two deaths also occurred among the adult animals. The first was on the ninth day after No. 2 vaccine, and blood films were reported to be positive. The second died on the day following inoculation, and blood films were negative.

Schedule of examinations.

(Including 1,860 specimens examined at the Ipoh Branch
Laboratory.)

	1930.	1931.
Anthrax—		
Blood cultures (bullock):		
Positive	0	1
Negative	0	1
Cultures, post-mortem (bullock):		
Positive	0	4
Negative	0	0
Guinea-pig inoculations (cultures):		
Positive	0	4
Negative	0	0
Cholera—		
Positive	0	0
Negative	0	5
Cystitis (cultures from urine):		
<i>B. aertrycke</i>	—	1
<i>B. coli</i>	—	77
<i>B. coli</i> (atypical)	—	3
<i>B. friedlander</i>	—	1
<i>C. pyocyaneus</i>	—	3
<i>C. violaceum</i>	—	1
<i>Enterococci</i>	—	4
<i>S. aureus</i>	—	1
Negative	—	114

Diphtheria—

Inoculation has been on Loeffler's medium. In instances where smears from primary cultures revealed organisms resembling *C. diphtheriae*, Kirschner's* medium has been employed for plating, and, after from 30 to 48 hours' incubation at 37°C., suspicious colonies, nearly all of which showed haemolysis, were re-inoculated on to Loeffler's medium. By this technique, repeated when necessary, it has been possible to obtain pure cultures for further investigation and for virulence tests. The latter have been made by intra-cutaneous injections into two guinea-pigs, one of which received 500 units of anti-toxin before, and the other, 150 to 200 units five to six hours after, the inoculation. For these intra-cutaneous tests, 0.2 c.cms. of a saline or Lemco broth emulsion, from an 18-24-hour culture on Loeffler, is used. Up to six injections, including controls, are made in each pair of animals and, although a presumptive positive report is often made after 24 hours, observation is continued in order to record the development of superficial necrosis. The trial of the copper sulphate-tellurite medium (Allison) mentioned in the previous report has been discontinued. It appeared that on it some yeasts develop more readily than *C. diphtheriae*.

Throat swabs—	1930.	1931.
Positive cultures (including 43 contacts and 13 nasopharyngeal swabs)	253	224
Negative cultures	1,708	2,180
Virulence tests:		
Positive	—	21
Negative	—	11

The distribution of cases reported bacteriologically positive was as follows:

	1930.	1931.
Selangor—		
Kajang	0	0
Klang	9	2
Kuala Lumpur	66	64
Serendah	0	1
	<u>75</u>	<u>67</u>
Perak—		
Batu Gajah	1	3
Ipoh	35	27
Krian	1	0
Kuala Kangsar	1	6
Taiping	10	19
Tapah	0	4
Teluk Anson	1	2
	<u>49</u>	<u>61</u>

* Kirschner's medium is made by the addition of 5 per cent. defibrinated human or bullock's blood to Levinthal's cooked blood agar.

					1930.		1931.
Negri Sembilan—							
Gemas	...	...	...	...	1	...	0
Jelevu	...	...	...	...	1	...	0
Kuala Pilah	...	...	...	...	2	...	0
Seremban	...	...	...	...	7	...	6
Tampin	...	...	...	...	23	...	4
					<hr/>		<hr/>
					34	...	10
					<hr/>		<hr/>
Pahang—							
Bentong	...	...	...	...	0	...	1
Kuala Lipis	...	...	...	...	2	...	2
Kuantan	...	...	...	...	0	...	1
Pekan	..	...	...	...	1	...	0
Raub	...	...	...	...	1	...	0
					<hr/>		<hr/>
					4	...	4
					<hr/>		<hr/>
Dysentery (bacillary)—							
Faeces:							
<i>B. dysenteriae</i> (Shiga)	...	...	...	...	2	...	1
<i>B. dysenteriae</i> (Flexner)	...	...	...	...	22	...	9
Negative	...	...	...	...	120	...	104
Enteric Fevers—							
<i>Widal reactions.</i> —No change in the technique described in the previous report has been made during the year except that saline controls (3.6 per cent. NaCl) are employed.							
					1930.		1931.
Total Widal reactions performed	...	...	...	...	2,696	...	2,427
Cases with “H” and “O” agglutinins:							
<i>B. typhosus</i> positive	...	...	...	...	335	...	266
<i>B. paratyphosus A</i> positive	...	...	...	...	36	...	11
<i>B. paratyphosus B</i> positive	...	...	...	...	11	...	4
<i>B. paratyphosus C</i> positive	...	...	...	...	7	...	0
Type undiagnosed (“O” agglutinins only)	...	...	...	...	15	...	6
Cases with “H” agglutinins only (in one instance <i>B. typhosus</i> was isolated):							
<i>B. typhosus</i> , above 1/250 titre	...	...	...	...	—	...	11
<i>B. paratyphosus A</i> „	...	...	...	...	—	...	8
<i>B. paratyphosus B</i> „	...	...	...	...	—	...	7
<i>B. paratyphosus C</i> „	...	...	...	...	—	...	2
Blood cultures:							
<i>B. typhosus</i> isolated	...	...	...	...	2	...	6
Negative	...	...	...	...	47	...	67

	1930.	1931.
Cultures from faeces :		
<i>B. typhosus</i> isolated	63	21
<i>B. paratyphosus A</i> isolated	6	1
Negative	662	471
Cultures from urine :		
<i>B. typhosus</i> isolated	42	21
<i>B. paratyphosus A</i> isolated	2	0
<i>B. paratyphosus B</i> isolated	0	1
Salmonella Group (unidentified)	0	1
Negative	423	408

The hospital distribution of the cases was as follows—

	1930.	1931.
Selangor :		
Kajang	1	2
Klang	9	6
Kuala Kubu	6	5
Kuala Lumpur	77	55
Port Swettenham	1	0
Serendah	2	1
	<hr/> 96	<hr/> 69
Perak :		
Batu Gajah	14	12
Chenderoh	3	0
Ipoh	24	24
Kampar	2	9
Krian	3	0
Kuala Kangsar	53	15
Parit Buntar	3	2
Sungei Siput	0	1
Sungkai	1	6
Tapah	3	4
Taiping	19	19
Tanjong Malim	6	1
Tanjong Rambutan	1	3
Teluk Anson	25	18
	<hr/> 157	<hr/> 114
Negri Sembilan :		
Gemas	1	0
Jelevu	3	1
Kuala Pilah	62	26
Port Dickson	2	0
Seremban	21	12
Tampin	3	6
	<hr/> 92	<hr/> 45

					1930.		1931.
Pahang :							
Bentong	...	...	...		4	...	2
Kuala Lipis	...	...	...		15	...	11
Kuantan	...	...	...		0	...	6
Mentakab	...	...	...		2	...	0
Raub	...	...	...		0	...	4
					<hr/> 21	...	<hr/> 23
Kedah :							
Alor Star	...	...	...		9	...	10
Kulim	...	...	...		1	...	2
Sungei Patani	...	...	...		1	...	5
					<hr/> 11	...	<hr/> 17
Perlis	...	...	...	...	1	...	2
Gonorrhoea—							
Urethral cultures :							
Positive	...	...	...	...	6	...	4
Negative	...	...	...	...	15	...	14
Leprosy—							
Nasal smears :							
Positive	...	...	...	...	1	...	4
Negative	...	...	...	...	39	...	28
Smears from nodules :							
Positive	...	...	...	...	10	...	12
Negative	...	...	...	...	36	...	38
Leptospirosis—							
Blood cultures :							
Positive	...	...	...	...	1	...	1
Negative	...	...	...	...	9	...	9
Dark ground examination of urine :							
Positive	...	...	...	...	0	...	4
Negative	...	...	...	...	63	...	40
Animal inoculation :							
Positive	...	...	...	...	3	...	1
Negative	...	...	...	...	11	...	11
Melioidosis :							
Positive cultures (cerebro-spinal fluid, lung, post-mortem and laboratory animals)	...	...	...	...	7	...	4
Negative	...	...	...	...	—	...	2

	1930.				1931.	
Meningitis—						
Cerebro-spinal fluid :						
<i>B. tuberculosis</i>	0	...	1
Meningococci	35	...	8
Pneumococci	14	...	15
Negative	125	...	92
Naso-pharyngeal cultures :						
Positive	2	...	0
Negative	201	...	13
Plague—						
Positive	0	...	0
Negative	1	...	0
Rat bite fever—						
Blood cultures :						
Positive	0	...	0
Negative	1	...	0
Animal inoculation :						
Positive	1	...	0
Negative	1	...	1
Tuberculosis—						
Sputum :						
Positive	2	...	0
Negative	23	...	17
Pus and body fluids :						
Positive	0	...	1
Negative	3	...	8
Guinea-pig inoculations (sputum and urine) :						
Positive	3	...	0
Negative	12	...	14

Tropical typhus—

During the first half-year no change was made in the technique employed for Weil-Felix reactions. Using Dreyer's technique, alcoholised suspensions of *Proteus* X, 19 "K" and "W" spreading motile strains were put up against each serum. Tubes were incubated in a water bath at about 50°C. Final readings were made 18 to 24 hours later and no tubes were discarded as negative until after that interval. Towards the end of the year parallel tests have been undertaken with living cultures using strains of the "O" variety obtained by the courtesy of Dr. Felix and Professor Young.

The Weil-Felix reaction has been performed on 2,427 human sera from 1,989 patients. In addition, 170 specimens from 100 experimental animals have been examined.

As regards the oil-palm plantation on which tropical typhus has, for several years past, been endemic, the number of cases known to have occurred during the year is 33

("K" type), compared with 59 cases in 1930 and 68 cases in 1929. The number for 1931 is probably an under-estimate for some of the milder cases may have escaped recognition. In the following table, the distribution of the typhus cases is shown, those from the endemic oil-palm plantation being included. Many cases included under Kuala Lumpur, Seremban, etc., occurred on neighbouring estates but were evacuated to the Government hospitals in the towns:

TABLE XLVIII.
DISTRIBUTION OF TROPICAL TYPHUS CASES.

State and District.					1930.			1931.		
					Type.		Total.	Type.		Total.
					"K."	"W."		"K."	"W."	
Selangor.—										
Banting	...	...	...	...	0	0	0	1	1	2
Batang Berjuntai	...	...	...	...	1	0	1	19	0	19
Kajang	...	...	...	...	0	0	0	0	1	1
Klang	...	...	...	...	0	5	5	4	0	4
Kuala Kubu...	...	...	...	...	0	0	0	6	0	6
Kuala Lumpur	...	...	...	...	78	19	97	75	21	96
Serendah	...	...	...	...	1	1	2	1	0	1
Sungei Buloh	...	...	...	...	0	0	0	1	0	1
Totals					80	25	105	107	23	130
Perak.—										
Batu Gajah	...	...	...	...	1	4	5	1	0	1
Ipoh	...	...	...	...	0	8	8	3	6	9
Kampar	...	...	...	...	0	0	0	0	1	1
Krian	...	...	...	...	0	1	1	1	0	1
Kuala Kangsar	...	...	...	...	4	2	6	5	1	6
Parit Buntar	...	...	...	...	0	0	0	2	1	3
Sitiawan	...	...	...	...	0	0	0	1	0	1
Taiping	...	...	...	...	3	2	5	2	0	2
Tanjong Malim	...	...	...	...	1	0	1	1	0	1
Teluk Anson	...	...	...	...	5	1	6	1	2	3
Totals					14	18	32	17	11	28
Negri Sembilan.—										
Jelevu	...	...	...	...	1	0	1	2	0	2
Kuala Pilah	...	...	...	...	1	2	3	5	1	6
Rompin	...	...	...	...	0	0	0	1	0	1
Seremban	...	...	...	...	2	6	8	7	3	10
Tampin	...	...	...	...	0	0	0	6	0	6
Totals					4	8	12	21	4	25
Pahang.—										
Bentong	...	...	...	...	2	0	2	2	0	2
Kuala Lipis	...	...	...	...	17	1	18	16	0	16
Kuantan	...	...	...	...	0	0	0	8	0	8
Mentakab	...	...	...	...	0	0	0	4	0	4
Raub	...	...	...	...	6	0	6	7	0	7
Totals					25	1	26	37	0	37

				1930.		1931.
Vaccines (autogenous):						
Number prepared	...	...		168	...	156

TABLE XLIX—(cont.)
RESULTS OF WATER EXAMINATIONS—(cont.)
(All figures refer to 20-24-hour readings.)

Source.	Number of samples.	Average number of colonies on agar (per c.cm.).	Lactose Fermenters.								
			Not detected in			Detected in					
			100 c.cms.	25 c.cms.	10 c.cms.	100 c.cms.	25 c.cms.	10 c.cms.	5 c.cms.	1 c.cm.	0.1 c.cm.
SELANGOR—(cont.)											
Kuala Lumpur—											
Ampang Intake Works:											
Raw water	49	195	...	...	...	...	...	...	...	49	...
Clear water well *	50	95	...	...	...	...	1	11	36	2	...
Ampang Impounding Reservoir:											
Raw water	45	129	...	...	...	...	...	...	...	45	...
Clear water well †	45	143	...	1	...	2	25	12	5	...	...
Kuala Selat—											
Raw water	50	263	...	...	...	...	...	...	...	50	...
Clear water well	50	64	...	...	...	1	28	17	4	...	...
Filter No. 1	25	77	...	...	...	...	7	9	9	...	...
„ No. 2	29	91	...	...	...	2	12	5	10	...	...
„ No. 3	26	93	...	...	...	...	11	9	6	...	...
„ No. 4	22	80	...	1	...	3	5	6	7	...	...
„ No. 5	16	99	...	...	...	...	4	6	6	...	...
„ No. 6	24	77	...	1	...	1	11	5	6	...	...
Standpipes—											
(a) Sanitary Board Office	29	51	...	...	...	...	16	8	5	...	...
(b) Residency	50	137	...	...	...	6	32	7	5	...	...
(c) Bungsar Road	51	83	...	...	...	3	24	16	8	...	...
Weld Hill Reservoir—											
Inlet pipe	24	18	7	1	...	3	4	7	1	1	...
Samples taken after complaint	2	43	...	...	...	...	2	...	...	...	...
(C) Filtered water: before “Caporite” added †	14	61	...	...	...	1	...	10	...	3	...
(E) Shortly after the addition of caporite	14	23	10	...	...	2	...	2	...	...	...
(F) From main below	13	27	3	...	...	7	...	2	...	1	...
(X) Filtered water: before chlorination *	73	83	...	...	...	...	6	5	52	10	...
(Y) Samples taken just below chlorination point	71	40	16	...	...	25	5	10	11	4	...
(Z) Samples from main about ½ mile below c.p.	80	40	29	...	...	22	6	10	9	4	...
(W) Samples from main to about 4½ miles below c.p.	10	44	1	...	...	5	2	1	...	1	...
Swimming pools	2	1 count- less 1,050	...	...	...	...	...	...	2	...	...
Petaling Kuchai—											
Well	1	2,250	...	...	...	...	...	...	...	...	1
Serdang Plantation Impounding Reservoir—											
Raw water	6	400	...	...	...	...	...	...	...	6	...
Mechanical filter	7	1 count- less 80	...	2	...	1	2	1	1	...	...
Filtered water ... ..	...	...	...	...	...	...	...	...	...	...	...
Well	1	187	...	...	...	...	...	...	1	...	...
Sungei Besi—											
Well	1	560	...	...	...	...	...	1	...	...	...
Sungei Buloh—											
Raw water	8	409	...	...	...	...	...	...	...	8	...
Filtered water	8	72	...	...	...	1	...	3	4	...	...
Ulu Langat River—											
Raw water	2	1,190	...	...	...	...	...	...	...	1	1

* Two samples under each of these headings are common to both.
† Thirty-seven samples under each of these headings are common to both.

TABLE XLIX—(cont.)
RESULTS OF WATER EXAMINATIONS—(cont.)
(All figures refer to 20-24-hour readings.)

Source.	Number of samples.	Average number of colonies on agar (per c.cm.).	Lactose Fermenters.									
			Not detected			Detected in						
			100 c.cms.	25 c.cms.	10 c.cms.	100 c.cms.	25 c.cms.	10 c.cms.	5 c.cms.	1 c.cm.	0.1 c.cm.	0.01 c.cm.
PERAK—(cont.)												
Tapah and Chenderiang—												
Raw	8	788	...	...	...	...	...	...	...	1	7	...
Filtered	36	163	...	...	...	...	...	2	7	27	...	...
Service reservoir	3	162	...	...	...	...	...	1	...	2	...	...
Well No. 1 (Filtered)	1	87	...	...	...	...	...	1	...	...	...	...
Well No. 2 (Raw)	1	1,350	...	...	...	...	...	...	...	...	1	...
Teluk Anson and Bagan Datoh—												
Well, raw	2	12	...	...	2	...	...	...	...	...	...	...
Raw (Changkat Jong)	8	1,969	...	...	...	...	...	...	...	2	6	...
Filtered (sand filter)	3	count- less	...	...	...	...	...	...	...	...	...	...
Standpipe	2	58	...	1	...	...	...	...	1	1	...	...
Estate No. 1—		184	...	...	...	...	...	...	1	1	...	...
Raw	2	1,540	...	...	...	...	...	...	...	...	2	...
Filtered	2	413	...	...	...	...	...	1	...	1	...	...
Estate No. 2—												
Raw	1	241	...	...	...	...	...	...	...	...	1	...
Filtered	1	10	...	1	...	...	...	...	...	...	...	...
Estate No. 3—												
Raw	2	775	...	...	...	...	...	...	...	1	1	...
Filtered	2	count- less	...	...	...	...	...	...	...	...	...	...
Filtered	2	17	...	1	...	...	...	1	...	...	...	...
NEGRI SEMBILAN.												
Bahau, Sungai Serling—												
Raw	17	1 count- less	...	...	...	...	...	...	...	...	17	...
After sedimentation, aeration and addition of alum	18	867	...	...	...	...	...	...	...	...	...	...
Filtered	14	72	...	...	6	...	...	7	...	5	...	...
After addition of lime and chlorine	16	2	...	13	...	...	1	...	...	...	...	...
Standpipe	7	2	...	16	...	...	...	...	...	...	...	...
Gemas—												
Raw water	7	33	...	3	...	...	3	...	...	1	...	...
After sedimentation, aeration and addition of alum	17	516	...	...	...	...	...	...	...	...	17	...
After addition of alum and lime	17	123	...	...	7	...	...	3	...	2	5	...
After addition of alum, lime and chlorine	4	10	...	3	...	...	...	1	...	...	...	...
Service reservoir, filtered	17	7	...	16	...	...	1	...	...	...	...	...
Standpipe in town	4	53	...	2	...	...	1	...	1	...	...	...
Kuala Pilah—												
Inlet to service reservoir	17	35	...	6	...	...	2	...	5	2	...	...
Standpipe, Water Works	2	224	...	...	...	...	...	...	...	2	1	...
Standpipe	2	91	...	...	...	...	...	...	...	2	...	...
Pedas—												
Well	2	199	...	...	...	...	...	...	...	2	...	...
Well	1	count- less	...	...	...	...	...	...	...	...	...	1
Port Dickson—												
Well	1	169	...	...	...	...	...	...	...	...	1	...
Standpipe	1	80	...	...	...	...	...	1	...	...	...	...
Sungei Beringin, Raw	2	159	...	...	...	...	...	...	...	...	2	...
Standpipe No. 1.	1	170	...	...	...	...	...	...	...	...	1	...
Standpipe No. 2.	1	128	...	...	...	...	...	...	...	...	1	...
Rembau—												
Wells	4	1 count- less	...	...	...	...	...	...	...	...	...	...
Tampin—												
Raw	2	1,584	...	...	...	...	...	...	...	3	1	...
Filtered	3	82	...	...	...	...	...	...	...	...	2	...
Filter bed	2	52	...	...	...	...	1	...	1	1	...	...
Standpipe	1	11	...	...	...	...	1	...	...	1	...	...
Standpipe	1	65	...	...	...	...	...	...	...	1	...	...

Examination of Aerated Water.

During the year, a number of samples of aerated waters have been examined :

TABLE LI.

Source.	Number of samples.	Twenty-four hours.				“Storm” Reaction Positive.	Forty-eight hours.					“Storm” Reaction Positive.
		Average number of colonies per c.cm.		Lactose Fermenters not detected in	Average number of colonies per c.cm.		Lactose Fermenters.					
							Not detected in	Detected in				
		Agar.	MacConkey.	25 c.cms.	Agar.		MacConkey.	25 c.cms.	25 c.cms.	10 c.cms.		
SELANGOR.												
Kuala Lumpur, Factory No. 1—												
Ginger Beer... ..	2	2	1	2	0	4	2	1	1	...	0	
Ice Cream Soda ...	3	18	9	3	0	47	25	2	...	1	0	
Lemonade ...	2	2	1	2	0	2	1	2	...	...	0
Orange Crush ...	1	2	0	1	0	3	1	1	...	...	0
Sarsaparilla ...	1	3	1	1	0	4	1	1	...	...	0
Soda Water ...	2	1	1	2	0	3	2	1	1	...	0	
Kuala Lumpur, Factory No. 2—												
Ginger Ale ...	1	1	0	1	0	2	0	1	...	...	0
Ice Cream Soda ...	1	1	0	1	0	1	0	1	...	...	0
Lemonade ...	1	0	0	1	0	0	0	1	...	...	0
Orangeade ...	1	3	0	1	0	5	0	1	...	...	0
Orange Crush ...	2	3	0	2	0	5	0	2	...	...	0
Soda Water ...	1	5	0	1	0	6	0	1	...	...	0
Tonic ...	2	1	0	2	0	1	0	2	...	...	0
Kuala Lumpur, Factory No. 3--												
Orange Crush ...	1	26	3	1	0	28	8	1	...	...	0
PERAK.												
Kuala Kangsar, Factory No. 1—												
Cream Soda ...	2	114	1	2	0	133	2	2	...	...	0

DIVISION OF PATHOLOGY.

(DR. R. LEWTHWAITE.)

Rabies Prophylaxis.

The “C” strain of fixed virus which was obtained in 1924 from the Pasteur Institute, Coonor, was in the 748th passage at the end of 1931. This strain was originally obtained from the Pasteur Institute, Paris. The “L” strain from Colombo was in its 358th passage. The virulence of these two strains has remained fixed, and each batch of vaccine is a mixture of the two strains.

Two other strains obtained from the Pasteur Institute, Saigon, are not at present used for vaccine production. One of these, which was originally fixed thirty years ago in Paris, has now completed 1,650 passages. The other one, which was fixed in Saigon from a case of “street” rabies, has completed 76 passages.

Results of Anti-rabies Treatment.

(Arranged according to the recommendations of the Health Organisation, League of Nations.)

1.—METHOD OF TREATMENT.

- (a) Light and medium cases ... Semple's 14 daily injections of 2×2.5 c.cms.
 Severe cases Semple's 21 daily injections of 2×2.5 c.cms.
- (b) If a preservative such as glycerine or carbolic acid is used, during what period of preservation is the vaccine considered efficient?
 Unused vaccine is discarded after six months.

TABLE LII.

2.—STATISTICS OF ALL PATIENTS.

No. of cases.			No. of fatal cases.			Percentage mortality.
1930.	1931.		1930.	1931.		
160	...	105	...	0	...	0

TABLE LIII.

3.—CLASSIFICATION ACCORDING TO RACE.

	No. of cases.		Percentage of total (1931).	No. of fatal cases.		Percentage mortality.
	1930.	1931.		1930.	1931.	
Europeans	...	28	...	18	...	17.1
Eurasians	...	2	...	7	...	6.7
Malays	...	21	...	11	...	10.5
Chinese	...	30	...	31	...	29.6
Indians	...	79	...	38	...	36.1

TABLE LIV.

4.—DISTRIBUTION OF THE CASES.

Nationality.	Ipoh.	Kuala Lumpur.	Seremban.	Singapore.	Penang, Butterworth and Province Wellesley.	Kedah.	Kelantan.	Total.
Europeans	...	1	—	1	—	11	5	18
Eurasians	...	—	3	—	3	1	—	7
Malays	...	1	—	—	1	3	1	5
Chinese	...	—	8	—	7	13	3	31
Indians	...	2	8	—	7	19	2	38
Totals	...	4	19	1	18	47	11	5
								105

TABLE LV.

5.—CLASSIFICATION ACCORDING TO VARIETY OF BITING ANIMAL.

	No. of cases.		Percentage of total.	No. of fatal cases.		Percentage mortality.
	1930.	1931.		1930.	1931.	
Dog	...	92	...	87.6	...	0
Cat	...	13	...	12.4	...	0

TABLE LV (A).

EVIDENCE OF RABIES IN BITING ANIMAL.

		No. of cases.		Percentage of total.		No. of fatal cases.		Percentage mortality.
Category A	...	64	...	64	...	0	...	0
„ B	...	10	...	10	...	0	...	0
„ C	...	24	...	24	...	0	...	0
„ D	...	2	...	2	...	0	...	0
Not reported	...	5	...	—	...	0	...	0

TABLE LVI.

6.—DEPTH OF LESIONS.

		No. of cases.		Percentage of total.		No. of fatal cases.		Percentage mortality.
Deep	...	35	...	34.0	...	0	...	0
Superficial	...	27	...	26.2	...	0	...	0
No visible lesion	...	41	...	39.8	...	0	...	0
Not reported	...	2	...	—	...	—	...	—

TABLE LVII.

7.—INTERPOSITION OF CLOTHING.

		No. of cases.		Percentage of total.		No. of fatal cases.		Percentage mortality.
Bare skin	...	40	...	60.6	...	0	...	0
Through clothing	...	22	...	39.4	...	0	...	0

TABLE LVIII.

8.—POSITION OF BITE.

		No. of cases.		Percentage of total.		No. of fatal cases.		Percentage mortality.
Head	...	6	...	10.3	...	0	...	0
Arm	...	18	...	31.0	...	0	...	0
Trunk	...	2	...	3.5	...	0	...	0
Legs	...	32	...	55.2	...	0	...	0
Not reported	...	4	...	—	...	—	...	—

TABLE LIX.

9.—NUMBER OF DAYS AFTER BITE OR CONTACT WHEN
TREATMENT WAS COMMENCED.

		1930.		1931.						Percentage mortality.
		No. of cases.	Percentage of total.	No. of cases.	Percentage of total.	No. of fatal cases.				
0—4	...	71	51.2	61	70.1	0	...	0	...	0
5—7	...	23	16.6	14	16.1	0	...	0	...	0
8—14	...	28	20.0	10	11.5	0	...	0	...	0
15—21	...	7	5.0	1	1.1	0	...	0	...	0
Over 21	...	10	7.2	1	1.1	0	...	0	...	0
Not reported	...	21	—	18	—	0	...	0	...	0

10. Any further facts or information pertaining to the above figures.

Paragraph 6: The number 41 is the number of those actually bitten but with no visible lesion at the time of consultation together with those who merely came into contact with the saliva of the rabid animals.

11. If paralytic accidents have been observed during the year, please give as detailed information as possible—Nil observed.

12. No case of hydrophobia has been reported to this Institute during the year.

Rabies in Animals.

Eighty-five brains from animals were submitted by the Veterinary Department of Malaya.

The following tables show the result of examination for Negri bodies (smears and sections), the areas from which they were sent, and the species of animals from which they were obtained:

TABLE LX.

SPECIES OF ANIMALS EXAMINED.								
		Positive.		Negative.		Decomposed.		Total.
Dog	...	33	...	42	...	3	...	78
Cat	...	2	...	5	...	—	...	7

TABLE LXI.

SHOWING AREA FROM WHICH THE BRAIN WAS FORWARDED.									
			Positive.		Negative.		Decomposed.		Total.
Selangor	...	...	5	...	18	...	0	...	23
Perak	...	...	1	...	2	...	0	...	3
Negri Sembilan	...	...	0	...	5	...	0	...	5
Pahang	...	...	0	...	1	...	0	...	1
Singapore	...	...	0	...	3	...	0	...	3
Penang and Province									
Wellesley	...	...	23	...	9	...	1	...	33
Kedah	...	...	4	...	8	...	2	...	14
Kelantan	...	...	2	...	1	...	—	...	3

The Preparation of Anti-rabies Vaccine.

During the year, 21,000 c.cms. of human anti-rabies vaccine (Semple's) were prepared and distributed to the various treatment centres throughout the Peninsula, and 2,500 c.cms. of canine anti-rabies vaccine were prepared and issued to the Veterinary Authorities.

The mass inoculation of dogs in the Kuala Lumpur Sanitary Board area was undertaken early in the year 1930. The procedure adopted and results obtained were described at length in the annual report for that year. In view of a complete absence of rabies in Kuala Lumpur during the year following compulsory inoculation, vaccination of dogs was not enforced in 1931. In the later months of that year, however, rabies reappeared in this area and it was consequently decided to re-enforce vaccination in January, 1932. Towards the end

of the year 28,000 c.cms. of canine anti-rabies vaccine were accordingly prepared and held in readiness for issue to the State Veterinary Surgeon, Selangor. The method employed in preparation was similar to that described in the report for 1929.

Morbid Histology.

The total number of specimens received for histological diagnosis numbered 427; of these, 46 were examined at the Ipoh Branch Laboratory. In addition, 62 specimens from the post-mortems made at the District Hospital, Kuala Lumpur, by the Assistant Pathologist were also examined.

Details of benign and malignant tumours are given below:

TABLE LXII.
BENIGN TUMOURS.

Serial No.	Nationality.	Sex.	Age.	Site of Tumour.	Nature of growth.
1	European	M.	20	Back	Haemangioma
2	"	M.	...	—	Lipoma
3	"	M.	52	Cerebellum	Glioma
4	Malay	F.	2	Buttock	Haemangioma
5	"	M.	8	Back	"
6	"	M.	11	Ear	Fibroma
7	"	M.	17	Parotid	"Parotid Tumour"
8	"	F.	28	Thyroid gland	Cyst-adenoma
9	"	F.	30	Tongue	Fibroma
10	"	F.	30	Parotid gland	"Parotid Tumour"
11	"	F.	30	Tongue	Fibroma
12	"	M.	30	Foot	Fibroma (recurrent)
13	Chinese	M.	5/12	Forearm	Fibroma
14	"	F.	16	Jaw	Odontoma
15	"	F.	22	Uterus	Fibromyoma
16	"	M.	23	Penis	Papilloma
17	"	F.	27	Knee	Adenoma
18	"	M.	30	Kidney	Lipoma
19	"	M.	30	Arm	Fibroma
20	"	M.	30	Parotid gland	"Parotid Tumour"
21	"	F.	35	Thyroid	Adenoma
22	"	M.	36	Bladder	Leiomyoma
23	"	M.	37	Brain	Glioma
24	"	M.	40	Parotid gland	"Parotid Tumour"
25	Indian	F.	1	Chest	Haemangioma
26	"	M.	4	Tongue	Lymphangioma
27	"	M.	10	"	"
28	"	M.	16	Ear	Fibroma
29	"	F.	19	Ovary	Cyst-adenoma
30	"	F.	20	Cervix	Fibroma
31	"	M.	20	Breast	Fibro-adenoma
32	"	M.	24	Palate	Fibroma
33	"	M.	25	Abdominal wall	"
34	"	M.	28	Penis	Papilloma
35	"	M.	29	Optic nerve	Neuro-myxoma
36	"	M.	30	Thyroid gland	Adenoma
37	"	F.	31	"	"
38	"	M.	33	Jaw	Fibroma
39	"	M.	39	Skin	Fibroma (multiple)

TABLE LXIII.
MALIGNANT TUMOURS.

Serial No.	Nationality.	Sex.	Age.	Site of Tumour.	Nature of growth.
1	European	M.	...	Face	Rodent ulcer
2	" ...	M.	26	Testes	Seminoma
3	" ...	M.	45	Wrist	Epithelioma
4	" ...	F.	67	Breast	Carcinoma
5	Eurasian	M.	41	Hand	Epithelioma
6	Malay ...	M.	...	Leg	"
7	" ...	M.	13	Mouth	"
8	" ...	F.	14	Ovary	Papilliferous cyst
9	" ...	M.	15	Cervical glands ...	Lympho-sarcoma
10	" ...	M.	30	Palate and pharynx ...	Epithelioma
11	" ...	M.	30	Palate	"
12	" ...	F.	36	Ankle	"
13	" ...	M.	40	Cheek	"
14	" ...	M.	40	Leg	Sarcoma
15	" ...	F.	40	Hand	Epithelioma
16	" ...	F.	45	Lip	"
17	" ...	F.	50	Labium	"
18	" ...	M.	50	Abdominal wall ...	"
19	" ...	M.	53	Ear	"
20	" ...	M.	60	Toe	Melanotic sarcoma
21	" ...	F.	60	Eyc-lid	Epithelioma
22	" ...	M.	...	Stomach	Carcinoma
23	Chinese ...	M.	2	Kidney	Teratoma
24	" ...	M.	10	Leg	Epithelioma
25	" ...	M.	18	Tongue	Sarcoma
26	" ...	M.	18	Palate	Mixed-cell sarcoma
27	" ...	M.	23	Knee	Osteo-sarcoma
28	" ...	M.	24	Liver and pancreas ...	Secondary sarcoma
29	" ...	M.	25	Cervical glands ...	"
30	" ...	F.	27	Colon	Adeno-carcinoma
31	" ...	M.	30	Leg	Mycloid sarcoma
32	" ...	M.	30	Neck	Angio-sarcoma
33	" ...	M.	30	—	Epithelioma
34	" ...	F.	31	Ovary	Carcinoma
35	" ...	M.	31	Lungs, kidney, spleen	Secondary Lympho-sarcoma
36	" ...	M.	31	Penis	Epithelioma
37	" ...	F.	33	Colon	Carcinoma
38	" ...	F.	35	Neck	Sarcoma
39	" ...	M.	35	Heel	Epithelioma
40	" ...	F.	36	Cervix	Carcinoma
41	" ...	M.	37	Brain	Glioma
42	" ...	M.	38	Penis	Epithelioma
43	" ...	M.	39	Anus	Carcinoma
44	" ...	M.	40	Chest	"
45	" ...	M.	40	Cervical glands ...	Secondary carcinoma
46	" ...	F.	40	Ovary	Cyst-adenocarcinoma
47	" ...	M.	43	Cervical glands ...	Endothelioma
48	" ...	M.	43	Bronchus	Adeno-carcinoma
49	" ...	M.	43	Liver	Carcinoma
50	" ...	M.	45	Pancreas	"
51	" ...	M.	46	Rectum	Carcinoma
52	" ...	M.	46	Lung	Secondary carcinoma
53	" ...	M.	46	Brain	Glio-sarcoma
54	" ...	M.	47	Liver	Carcinoma
55	" ...	M.	47	Mediastinal glands ...	Sarcoma

TABLE LXIII—(cont.)
MALIGNANT TUMOURS—(cont.)

Serial No.	Nationality.	Sex.	Age.	Site of Tumour.	Nature of growth.
56	Chinese ...	M.	47	Face	Rodent ulcer
57	" ...	F.	47	Vagina	Carcinoma
58	" ...	M.	50	Oesophagus	Squamous cell carcinoma
59	" ...	M.	50	Cervical glands	Lympho-sarcoma
60	" ...	M.	51	Maxillary antrum	Carcinoma
61	" ...	F.	51	Cervix	Spindle-cell sarcoma
62	" ...	M.	53	Tongue	Lympho-sarcoma
63	" ...	M.	53	Elbow	Osteo-sarcoma
64	" ...	M.	53	Scalp	Sarcoma
65	" ...	M.	53	Mesenteric gland	Lympho-sarcoma
66	" ...	M.	54	Bronchus	Carcinoma
67	" ...	M.	55	Neck	Branchiogenic carcinoma
68	" ...	M.	55	Penis	Epithelioma
69	" ...	F.	56	Pelvis	Sarcoma
70	" ...	M.	56	Cervical glands	* Lymphogranulomatosis
71	" ...	M.	57	Lung	Secondary sarcoma
72	" ...	M.	59	Tongue	Epithelioma
73	" ...	M.	60	Cervical glands	Lympho-sarcoma
74	" ...	M.	60	Intestine	Carcinoma
75	" ...	M.	62	Brain	Glioma
76	" ...	M.	65	Colon	Carcinoma
77	" ...	M.	68	Cervical glands	Lympho-sarcoma
78	" ...	M.	78	Face	Epithelioma
79	" ...	M.	...	Stomach	Scirrhus carcinoma
80	" ...	M.	...	Lung	Secondary sarcoma
81	Indian ...	M.	5	Pelvis	Sarcoma
82	" ...	M.	10	Gall-bladder and pancreas	Secondary lympho-sarcoma
83	" ...	F.	15	Neck	Epithelioma
84	" ...	M.	20	Thigh	Sarcoma
85	" ...	M.	23	Cervical glands	* Lymphogranulomatosis
86	" ...	M.	28	Jaw	Epithelioma
87	" ...	M.	30	Leg	Myeloid sarcoma
88	" ...	M.	30	Cheek	Epithelioma
89	" ...	M.	30	Penis	"
90	" ...	F.	30	Intestine	Lympho-sarcoma
91	" ...	M.	30	Cheek	Epithelioma
92	" ...	M.	30	Femur	Myeloid sarcoma
93	" ...	F.	32	Abdominal wall	Carcinoma
94	" ...	M.	34	Testicle	Teratoma
95	" ...	M.	35	Abdominal wall	Carcinoma
96	" ...	M.	35	Cheek	Epithelioma
97	" ...	M.	38	Buttock	"
98	" ...	M.	38	Finger	"
99	" ...	M.	40	Kidney, stomach, liver	Secondary sarcoma
100	" ...	M.	45	Penis	Epithelioma
101	" ...	M.	45	Testes	Teratoma
102	" ...	F.	45	Vagina	Epithelioma
103	" ...	F.	46	Abdomen	"
104	" ...	M.	47	Cheek	"
105	" ...	F.	50	Gland	"
106	" ...	M.	50	Tongue	"
107	" ...	M.	50	Penis	"
108	" ...	M.	56	Tongue	"

* These cases are included in the table for the purpose of record.

Autopsies.

Post-mortem examinations have been carried out on 406 unclaimed bodies. The various causes of death are tabulated below :

TABLE LXIV.

General Bacterial Infections :						
Diphtheria	...	...	...	...	...	1
Dysentery (bacillary)	...	...	...	...	...	37
„ (mixed)	...	...	...	...	...	2
Gastro-enteritis	...	...	...	...	...	2
Influenza	...	...	...	...	...	2
Melioidosis (meningeal)	...	...	...	...	...	1
Pneumonia (lobar)	...	...	...	...	...	36
„ (lobular)	...	...	...	...	...	15
Pneumococcal meningitis	...	...	...	...	...	6
Pyæmia	...	...	...	...	...	5
Sepsis (prolonged suppuration)	...	...	...	...	...	5
Tuberculosis, bone	...	...	...	...	...	1
„ generalised	...	...	...	...	...	7
„ intestinal	...	...	...	...	...	2
„ meningeal	...	...	...	...	...	2
„ peritoneal	...	...	...	...	...	1
„ pulmonary	...	...	...	...	...	43
„ pulmonary and intestinal	...	...	...	...	...	37
Typhoid (one perforation)	...	...	...	...	...	2
Whooping-cough	...	...	...	...	...	1
Helminthic Infections :						
Ankylostomiasis	...	...	...	...	...	4
Ascariasis (one complicated by abscesses in liver and general peritonitis)	...	...	...	...	...	2
Protozoan Infections :						
Amoebiasis (intestinal)	...	...	...	...	...	6
Malaria	...	...	...	...	...	15
Malaria chronic (cachexia)	...	...	...	...	...	1
Spirochaetal Infections :						
Leptospirosis	...	...	...	...	...	1
Spirochaetosis, pulmonary	...	...	...	...	...	2
Syphilis (one meningeal)	...	...	...	...	...	5
Deficiency Diseases :						
Beri-beri	...	...	...	...	...	4
Diseases of Endocrine Glands :						
Thyroid, carcinoma	...	...	...	...	...	1
Diseases of Circulatory System :						
Arteriosclerosis	...	...	...	...	...	4
Endocarditis, ulcerative	...	{ mitral 3 ... aortic 2 ... mitral and aortic 1 ... }				6
Myocarditis	...	...	...	...	...	7
Pericarditis	...	...	...	...	...	1

TABLE LXIV—(cont.)

Diseases of Digestive System:					
Appendicitis	...	...	...	...	1
Buccal cavity, epithelioma	...	...	...	...	4
Oesophageal stricture (following poisoning)	...	...	...	corrosive	1
Gastric carcinoma	...	...	...	...	6
„ ulcer	...	...	...	...	1
Liver, carcinoma (primary)	...	...	...	...	7
„ cirrhosis	...	...	...	...	9
„ catarrhal jaundice	...	...	...	...	1
Pancreatitis	...	...	...	...	1
Peritonitis	...	...	...	...	5
Rectum, carcinoma	...	...	...	...	1
Diseases of Lymphatic System:					
Leukaemia, myelogenous	...	...	...	...	1
Lymphogranulomatosis	...	...	...	...	1
Diseases of Nervous System:					
Cerebral haemorrhage	...	...	...	...	3
Epilepsy	...	...	...	...	1
Hydrocephalus	...	...	...	...	1
Subdural haemorrhage	...	...	...	...	1
Diseases of Respiratory System:					
Bronchitis, capillary	...	...	...	...	1
Bronchus, carcinoma	...	...	...	...	2
Empyema	...	...	...	...	7
Lung, abscess	...	...	...	...	2
„ fibroid	...	...	...	...	1
Pyo-pneumothorax	...	...	...	...	2
Diseases of Uro-genital System:					
Cervix, carcinoma	...	...	...	...	2
Endometritis	...	...	...	...	2
Hypernephroma	...	...	...	...	1
Nephritis, chronic interstitial	...	...	...	...	11
„ „ parenchymatous	...	...	...	...	9
„ „ suppurative	...	...	...	...	10
Prostate, adenoma	...	...	...	...	1
Pyosalpinx	...	...	...	...	1
Diseases of Bone:					
Osteomyelitis, chronic	...	...	...	...	2
Diseases of Blood:					
Anaemia, primary	...	...	...	...	6
„ secondary	...	...	...	...	10
„ of pregnancy	...	...	...	...	1
Diseases of Skin:					
Cellulitis	...	...	...	...	5
Gangrene	...	...	...	...	1
Neoplasma, unclassified	...	...	...	...	7
Shock (post-operative)	...	...	...	...	1
Senility	...	...	...	...	1
Undiagnosed	...	...	...	...	7

Miscellaneous Examinations.

TABLE LXV.
(Specimens examined at the Ipoh Branch Laboratory and included below total 352.)

Biochemical Examinations:					
Blood sugar estimations	...	...	66	...	244
Blood urea estimations	...	...	62	...	
Glucose tolerance tests	...	...	72	...	
Fractional test meals	...	...	12	...	
Urea concentration tests	...	...	12	...	
Van den Bergh and Fouchet tests			20	...	30
Differential and total blood counts	...	...	...	...
Examination of body fluids:					
Ascitic fluid	...	...	2	...	130
Cerebro-spinal fluid	...	...	118	...	
Pleural exudate	...	...	8	...	
Synovial fluid	...	...	2	...	
Examination of faeces	...	...	...	...	103
Examination of urine	...	...	...	...	74
Miscellaneous examinations	...	...	...	...	57

Medico-Legal.

During the course of the year 302 exhibits submitted by 143 Police Officers were examined. The nature of these exhibits is shown below:

Blood stains	...	...	...	...	...	285
Slides for gonococci	...	...	...	...	...	4
Spermatozoa	...	...	...	...	...	9
Hairs	...	...	...	...	...	2
Miscellaneous	...	...	...	...	...	2

Human blood was demonstrated to be present in 164 of these exhibits. It is worthy of note that in two instances scales of a mosquito were seen in the blood stains. Sutherland has drawn attention to the similarity of stains left by the crushing of blood-sucking insects and blood stains and its importance in the examination of blood-stains in tropical countries. When the Teichmann test was done, mosquito scales were easily distinguishable among the haemin crystals.

Blood of ruminants was identified in three exhibits.

TABLE LXVI.							
DISTRIBUTION OF EXHIBITS OF BLOOD STAINS.							
Selangor.				Perak.			
Positive.		Negative.		Positive.		Negative.	
36	...	20	...	62	...	66	...

Negri Sembilan.				Pahang.			
Positive.		Negative.		Positive.		Negative.	
38	...	21	...	29	...	13	...

LYMPH STATION.

The demand for lymph was considerably less than in the previous year, the number of tubes issued being 68,800 as compared with 107,600. Smallpox, though still smouldering, was limited to the northern part of the country. The demand for lymph was fairly regular; it was not necessary to meet sudden and heavy demands such as were experienced last year. The following table gives the actual number of tubes issued month by month:

TABLE LXVII.

MONTHLY RETURN OF CAPILLARY TUBES (LYMPH).

Month.		Tubes filled.		Tubes issued.		Balance.
Brought forward	...	16,538	...	—	...	—
January	...	—	...	1,244	...	15,294
February	...	5,500	...	6,963	...	13,831
March	...	13,892	...	11,275	...	16,448
April	...	7,300	...	5,402	...	18,346
May	...	6,780	...	7,221	...	17,905
June	...	5,000	...	5,449	...	17,456
July	...	3,750	...	4,386	...	16,820
August	...	7,900	...	4,453	...	20,267
September	...	4,364	...	5,851	...	18,780
October	...	5,300	...	5,350	...	18,730
November	...	9,600	...	7,290	...	21,040
December	...	2,100	...	3,888	...	19,252
Totals	...	88,024	...	68,772	...	19,252

Buildings and Apparatus.

Buildings.—No modifications or additions to buildings have been made during the year.

Cold Storage.—The cold storage plant has continued to operate very satisfactorily.

Grinding Machines.—These machines have given satisfactory service.

Vacuum Pump.—The Geryk hand pump has now been superseded by an electrically driven Cenco pump.

Glycerin.—The question of acidity of glycerin was taken up with the Crown Agents. Samples from certain British manufacturers have been received and tested, and were found to be satisfactory. It is anticipated that future supplies will not be unduly acid in reaction.

Animals.

The rabbit-calf-buffalo cycle for lymph production has been continued. Malayan buffaloes have been used throughout the year on account of the higher yields which are obtainable from the Malayan as compared with the Indian variety. Supplies have been obtained from the State of Kedah, where the animals are inspected before entrainment, on behalf of the Institute by Mr. J. J. Fleury, the State Veterinary Surgeon. By the courtesy of the Siamese Government, arrangements have been completed whereby buffaloes will be obtainable from Siam in the event of Kedah being quarantined at any time. The following table indicates the yields obtained from vaccinated buffaloes :

TABLE LXVIII.
TABLE SHOWING YIELDS OF LYMPH (BUFFALO).

Breed of animal.	No. of animal.	Date of vaccination.	No. of hours before scraping.	Pulp (grammes).	Titre (1/4).	Date passed for issue.
Malayan buffalo	B 1/31	9.1	96	492	1/14,000	29.6
„	B 2/31	26.2	96	336	1/12,000	29.6
„	B 3/31	31.3	96	253	1/7,000	29.6
„	B 4/31	2.7	96	375	In course of preparation	
„	B 5/31	13.8	Failed to take satisfactorily			

Rabbits and Guinea-pigs.—White rabbits have been used for “lapine” production and white rabbits and Belgian hares for potency and virulence tests. The evaluation of potency by the intra-dermal method has been continued, and in all cases tests are carried out on at least two rabbits. Considerable variation in the reactions of individual rabbits has again been noted. Guinea-pigs have been employed for the testing of any suspicious cultures isolated from the lymph.

Calves.—Locally bred calves have been employed for the production of “calvine”. The following table shows the yield obtained :

TABLE LXIX.
TABLE SHOWING YIELDS OF LYMPH (CALF) 1931.
“Calvine.”

No. of animal.	Date vaccinated.	No. of hours before scraping.	Pulp (grammes).	Date first used.	Potency.
C 1/31	... 4th July	... 96	... 96	— ...	1/16,000

Technique and Tests.

There have been no changes in the technique employed in bacteriological or potency standards during the year.

Infant Vaccinations.

Dr. M. J. Were, Lady Medical Officer, has kindly continued to permit primary vaccinations to be undertaken at the Infant Welfare Centre, Kuala Lumpur, and by this means each batch of lymph has been thoroughly tested prior to general issue. One insertion has been made with lymph of a batch already issued, and a second insertion with lymph of a batch which has passed bacteriological and potency tests. The following tables give the Case Success Rate and the Insertion Success Rate for new batches :

TABLE LXX.
INFANT WELFARE CENTRE, CASE SUCCESS RATE.

Month.	No. of children vaccinated.		No. of children seen.		No. of children successfully vaccinated.		Case success rate. (Per cent.)	
January	...	100	...	49	...	49	...	100.0
February	...	74	...	44	...	43	...	97.7
March	...	326	...	145	...	144	...	99.3
April	...	340	...	144	...	143	...	99.3
May	...	200	...	94	...	93	...	97.9
June	...	129	...	96	...	95	...	98.9
July	...	165	...	119	...	117	...	98.3
August	...	179	...	119	...	119	...	100.0
September	...	110	...	74	...	74	...	100.0
October	...	294	...	184	...	183	...	99.5
November	...	174	...	122	...	121	...	99.2
December	...	67	...	29	...	29	...	100.0
Totals	...	2,158	...	1,219	...	1,210	...	99.3

TABLE LXXI.
INFANT WELFARE CENTRE, INSERTION RATE.
(Tests of Lymph prior to General Issue.)

Month.	Insertions.		Seen.		Perfect.		Modified.		Failed.		Insertion success rate. (Percentage.)
January	...	117	...	65	...	65	...	0	...	0	100.0
February	...	113	...	53	...	51	...	1	...	1	98.1
March	...	295	...	128	...	125	...	1	...	2	98.4
April	...	484	...	193	...	191	...	2	...	0	100.0
May	...	144	...	74	...	73	...	1	...	0	100.0
June	...	254	...	189	...	176	...	3	...	1	99.4
July	...	244	...	200	...	194	...	5	...	1	99.5
August	...	323	...	198	...	197	...	1	...	0	100.0
September	...	111	...	70	...	68	...	0	...	2	97.1
October	...	292	...	183	...	181	...	1	...	1	99.5
November	...	91	...	64	...	61	...	3	...	0	100.0
December	...	113	...	76	...	68	...	5	...	3	96.1
Totals	...	2,581	...	1,484	...	1,450	...	23	...	11	99.3

WASSERMANN AND KAHN REACTIONS.

The total number of specimens submitted for examination totalled 21,600 as compared with 17,300 for the previous year. Some eleven hundred sera were so haemolised or contaminated as to be unsuitable for the Wassermann reaction, and five hundred and fifty were found to be anti-complementary. The testing of most of the contaminated and anti-complementary specimens, however, was possible by means of the Kahn reaction.

TABLE LXXII.

WASSERMANN REACTIONS.

(Including Specimens examined at the Ipoh Branch Laboratory.)

Blood.

		Positive (including \pm).	Negative.	Unsuitable for test.	Anti-com- plementary.	Total.
Totals	{ 1930 ...	6,272 ...	10,147 ...	468 ...	293 ...	17,180
	{ 1931 ...	7,846 ...	12,073 ...	1,130 ...	557 ...	21,606
Per cent.	{ 1930 ...	36.6 ...	59 ...	2.7 ...	1.7 ...	100
	{ 1931 ...	36.3 ...	55.9 ...	5.2 ...	2.6 ...	100

Cerebro-spinal Fluid.

Totals	{ 1930 ...	37 ...	59 ...	— ...	1 ...	97
	{ 1931 ...	41 ...	98 ...	3 ...	— ...	142
Per cent.	{ 1930 ...	38.0 ...	61.0 ...	0 ...	1 ...	100
	{ 1931 ...	28.9 ...	69.0 ...	2.1 ...	0 ...	100

TABLE LXXIII.

KAHN REACTIONS.

(Including Specimens examined at the Ipoh Branch Laboratory.)

Blood.

		Positive (including \pm).	Negative.	Total.
Totals	{ 1930 ...	5,898 ...	9,751 ...	15,649
	{ 1931 ...	7,914 ...	11,745 ...	19,659
Per cent.	{ 1930 ...	37.8 ...	62.2 ...	100
	{ 1931 ...	40.3 ...	59.7 ...	100

DIVISION OF CHEMISTRY.

(MR. R. W. BLAIR.)

Water.

The number of samples from existing water supplies for chemical examination was 2,221 as compared with 2,049 in 1930. Weekly examinations of raw and filtered waters of the Kuala Lumpur supplies have been continued. The Kuala Lipis supply has also been examined weekly, the Kinta supply fortnightly, and the following supplies have been examined at monthly intervals: Bagan Serai, Bagan Datoh, Bahau, Batu Gajah, Bentong, Beserah, Fraser's Hill, Gemas, Gopeng, Ipoh, Kampar, Kajang, Kuala Kubu, Kuala Kangsar, Kuantan, Mentakab, Parit Buntar, Raub, Rawang, Seremban, Taiping, Tampin, Tanjong Rambutan, Tapah and Teluk Anson.

Various new schemes for purification were put into operation during the year. In addition to the usual processes (viz., storage, sedimentation and filtration), chlorination is being adopted as a *final* method of purification in an increasing number of supplies. This safeguard has frequently been recommended. It is relatively inexpensive and ensures a low bacterial count, though, unless the dose is carefully controlled, an unpleasant taste may result.

The chlorination of filtered water at the Intake Works, Ampang (Kuala Lumpur water supply), has been continued and the dosage steadily increased from 0.2 to 0.6 parts per million with satisfactory results as regards taste and purity.

The results of chemical examination of water supplies are being tabulated and will be published shortly as a Bulletin.

The yearly averages of the results of chemical examinations are shown in Tables LXXIV to LXXXIV.

Milk.

According to "The Sale of Food and Drugs Enactment, 1913," the quantity of milk fat present in milk must not be less than 3.25 per cent., and the quantity of milk solids other than milk fat must not be less than 8.5 per cent. of the total component parts. Eight hundred and eighty-nine samples of milk have been submitted by the Health Authorities for examination, and of these, 12 (1.3 per cent.) were found to be deficient in milk fat, and 55 (6.2 per cent.) to be deficient in milk solids other than fat. One sample (0.1 per cent.) was deficient in both milk fat and non-fatty solids.

Condensed Milk.

The following standards for condensed milk are prescribed under "The Food and Drugs Enactment, 1913":

	Milk fat.	Milk solids (including milk fat).
Sweetened condensed milk ...	9%	31%
Unsweetened condensed milk ...	8%	28%

Twenty-one samples of sweetened condensed milk were received for examination, of which five were found to comply with the above standards and 16 were deficient in milk fat. One sample of unsweetened condensed milk was satisfactory. A sample of machine-skimmed milk, which can only be imported under special licence, was also examined: no standards have as yet been laid down for milk of this nature.

Toxicological Examinations.

The exhibits received from all sources under this heading totalled 212, and included viscera, stomach contents, vomit, faeces, urine and medicine. The poisons identified were the alkaloids of datura, morphine, strychnine, cyanide, acetic and formic acid, alcohol, lysol and mercury.

Of special interest is the increased number of exhibits which shew positive indication of drugging by datura; alkaloids from this source were identified in nine samples of urine, eight of stomach wash, seven of vomit, and seven of food.

The following are résumés of cases of interest:

- (1) A male Chinese purchased some seeds from a Chinese drug store; after drinking a decoction made from the seeds he became ill and died in convulsions. The viscera and a sample of seeds were forwarded for analysis, and $\frac{1}{3}$ grain of strychnine was isolated from the viscera, while the seeds were identified as those of *Strychnos ignatii*.
- (2) A male Chinese died shortly after drinking a decoction made from a root supplied to him by a medicine man. The viscera and a specimen of the root were submitted for examination. The root, which closely resembled *Gelsemium*, contained an alkaloid, and a small quantity of an alkaloid was also isolated from the viscera. This was not identified, but a small quantity injected into a rat caused death with signs similar to those occurring in a second rat which had been injected with the alkaloid obtained from the root.
- (3) A specimen of faeces was forwarded from a case of diarrhoea and abdominal pain, in which poisoning was suspected. On shaking the faeces with a saturated salt solution and centrifuging, a scum was obtained which, on microscopical examination proved to contain numerous fine bamboo hairs. This material is sometimes employed as a poison. Gimlette (Malay Poisons and Charms).

Cosmetics.

In 1930 Professor R. B. Hawes observed symptoms suggestive of lead poisoning in a number of Chinese girls in Singapore and it was subsequently discovered that certain brands of face powder contained lead compounds. A number of samples of local face powder was accordingly submitted for examination by the Health Authorities of the Federated Malay States, and of 54 such samples, 14 were found to contain lead, usually in the form of the carbonate, one specimen containing as much as 48 per cent. (PbCO_3). As the result of this investigation the following rule was gazetted under section 27 of "The Sale of Food and Drugs Enactment, 1913"—"No lead or any compound thereof shall be added to, or be an ingredient or component part of any cosmetic preparation". Subsequently, a further rule was made prohibiting the sale, advertisement for sale, or importation of cosmetics containing lead or any compound thereof.

Sewage Effluents.

Samples of sewage and resulting effluents from a number of septic tank installations have been examined. The specimens numbered 106 as compared with 93 in 1930.

Biochemical Examinations.

During the year the following biochemical examinations were carried out:

Blood serum for calcium	...	...	...	95
Blood serum for protein	...	...	...	8
Blood plasma for phosphorus	...	...	...	5
Blood for oxygen	...	...	...	6
Blood for non-protein nitrogen	...	...	...	4
Blood for glucose	...	...	...	4
Blood for uric acid	...	...	...	2
Faeces for fat	...	...	...	9
Urine for sugars	...	...	...	5
Urine for the preparation of proteose	...	...	...	5
Urine for iodine	...	...	...	2
Urine for diastatic index	...	...	...	1
Urinary calculi	...	...	...	1

Deleterious Drugs.

Twenty-four substances suspected to contain drugs specified in "The Deleterious Drugs Enactment" were submitted. Eighteen of these contained portions of the plant *Cannabis sativa* (Ganja) from which resin had not been extracted.

In one sample of pills opium was found.

Coins and Coining Material.

One thousand one hundred and sixty-six exhibits in counterfeit coining cases were received. Of these, 891 were found to be counterfeit and 55 to be genuine coins. Other exhibits, 220 in number, included moulds and miscellaneous material used in the manufacture of counterfeit coins.

Other Exhibits.

In addition to toxicological and coining material, 194 exhibits were received from the Police authorities, as compared with 79 in the previous year. Exhibits in connection with shooting cases included 23 rounds of ammunition, eight empty cartridge cases, six bullets, five pistols, two revolvers and one gun.

An automatic pistol from an arrested person together with empty cartridge cases found at scenes of various gang robberies were submitted. Characteristic marks on these cartridge cases, caused by striker pin and ejector, were similar to those seen on cases fired by the automatic pistol in the laboratory. It was thus demonstrated that all the cartridge cases had been fired from this pistol and that several robberies were the work of one gang.

Other exhibits comprised currency notes, documents, Embassy cigarette coupons, clothing, fire-works, medicines, acids, wood and a number of sharp-pointed bamboo sticks found stuck in the ground to impede pursuit by the police. The last were examined for poisons with negative results.

Instruction.

A course of five lectures on scientific criminal investigation was given to officers of the Federated Malay States Police. Chemical analyses consist in the gradual elimination of possibilities; poisons are numerous, and the quantity which can be isolated from viscera, etc., is extremely small. As the result of this course of lectures, Police Officers are better realising the necessity of supplying adequate particulars with toxicological exhibits. Much useless chemical work is thereby avoided and the probability of obtaining positive results increased.

Miscellaneous.

Many miscellaneous specimens were received and reported on to various Government departments.

Examinations undertaken for firms and private individuals totalled 19.

Evidence was given in legal proceedings on three occasions by the staff of the Division.

TABLE LXXIV.

KUALA LUMPUR WATER SUPPLY.

Chemical Averages for each month of the year 1931.

Parts per 100,000 (unless otherwise stated).

KUALA SLEH SUPPLY—RAW WATER (50 SAMPLES).

1931. Month.	Colour M.M. Brown 2-ft. tube, Burgess's Tintometer.	Reaction pH.	Ammoniacal nitrogen.	Albuminoid nitrogen.	Oxidised nitrogen.	Oxygen absorbed from acid permanganate in 3 hours at 80° F.	Chlorides expressed as chlorine.	Total solids.	Total hardness.	Rainfall in inches (total).
Averages 1930 ...	27	6.7	.0001	.0049	.004	.131	.08	4.14	0.4	84.68
January ...	19	6.6	.0001	.0042	.003	.113	.08	3.25	0.6	5.02
February ...	16	6.8	.0002	(.0035)	...	.106	.10	...	...	1.06
March ...	29	6.6	.0002	.0102	...	.193	.08	...	...	6.41
April ...	34	6.8	.0004	.0062	...	.186	.08	...	...	6.23
May ...	34	6.7	.0000	.0054	...	.167	.09	...	...	7.34
June ...	24	6.6	.0001	.0051	...	.141	.08	...	...	5.89
July ...	24	6.7	.0000	.0050	.003	.135	(.07)	(3.15)	(0.5)	7.32
August ...	15	6.8	.0001	.0042	...	(.091)	.08	...	...	0.37
September ...	15	6.7	.0001	.0056	...	.117	(.07)	...	...	6.66
October ...	(12)	6.7	.0000	.0048	...	.109	(.07)	...	...	2.17
November...	(12)	(6.5)	.0000	.0045	...	.116	(.07)	...	...	14.33
December	14	(6.5)	.0000	.0041	...	.114	.08	...	...	14.73
Averages 1931 ...	21	6.7	.0001	.0052	.003	.132	.08	3.20	0.5	77.53

The highest and lowest results are printed in italics and bracketed respectively.

TABLE LXXV.
KUALA LUMPUR WATER SUPPLY.
Chemical Averages for each month of the year 1931.
Parts per 100,000 (unless otherwise stated).
KUALA SLEH SUPPLY—FILTERED WATER (50 SAMPLES).

1931. Month.	Colour M.M. Brown 2-ft. tube, Burgess's Tintometer.	Reaction pH.	Ammoniacal nitrogen.	Albuminoid nitrogen.	Oxidised nitrogen.	Oxygen absorbed from acid permanganate in 3 hours at 80° F.	Chlorides expressed as chlorine.	Total solids.	Total hardness.
Averages 1930	19	6.7	.0001	.0028	.009	.081	.08	3.45	0.4
January ...	16	6.7	.0000	.0031	.009	.072	(.07)	3.50	0.3
February ...	15	6.8	.0000	(.0023)	...	.068	.09	...	...
March ...	26	6.8	.0000	.0032	...	.112	.10	...	...
April ...	25	6.8	.0000	.0036	...	.102	.08	...	...
May ...	30	6.8	.0000	.0030	...	.107	.08	...	...
June ...	23	6.7	.0000	.0034	...	.095	(.07)	...	...
July ...	19	6.7	.0000	.0032	...	.085	(.07)	...	...
August ...	11	6.6	.0000	.0026	...	.063	.08	...	...
September ...	15	6.7	.0000	.0024	...	.076	(.07)	...	...
October ...	10	6.7	.0000	.0026	...	.067	(.07)	...	...
November ...	(9)	6.6	.0000	.0032	...	.088	(.07)	...	...
December ...	10	(6.5)	.0000	.0024	...	(.061)	.08	...	...
Averages 1931	17	6.7	.0000	.0029	.009	.083	.08	3.50	0.3

TABLE LXXVI.
KUALA LUMPUR WATER SUPPLY.
Chemical Averages for each month of the year 1931.
Parts per 100,000 (unless otherwise stated).
IMPOUNDING RESERVOIR—RAW WATER (45 SAMPLES).

1931. Month.	Colour M.M. Brown 2-ft. tube Burgess's Tintometer.	Reaction pH.	Ammoniacal nitrogen.	Albuminoid nitrogen.	Oxidised nitrogen.	Oxygen absorbed from acid permanganate in 3 hours at 80° F.	Chlorides expressed as chlorine.	Total solids.	Total hardness.	Rainfall in inches. (total).
Averages 1930	31	6.5	.0006	.0075	.001	.151	.07	3.00	.5	90.48
January ...	26	6.4	.0007	.0090	...	.142	.08	(2.50)	0.6	8.37
February ...	20	6.6	.0004	.0075	...	(.136)	.08	...	...	3.62
March ...	22	6.4	.0012	(.0062)	...	.142	.07	...	...	11.18
April ...	33	6.4	.0007	.0069	...	.156	.07	...	...	8.08
May ...	36	6.4	.0006	.0079	...	.156	.07	...	...	8.71
June ...	26	6.4	.0018	.0080	...	.155	.07	...	...	8.12
July ...	28	6.4	(.0001)	.0097	.000	.150	.07	3.65	(0.2)	6.93
August ...	21	6.4	.0003	.0075	...	(.136)	.07	...	...	3.45
September ...	19	(6.3)	.0660	.0160	...	.186	(.06)	...	...	9.66
October ...	(13)	(6.3)	.0600	.0072	...	.148	.07	...	...	7.74
November ...	15	6.4	.0009	.0086	...	.157	.07	...	...	12.77
December ...	18	6.4	.0003	.0070	...	.148	.08	...	...	14.58
Averages 1931	23	6.4	.0061	.0085	.000	.151	.07	3.07	0.4	103.21

The highest and lowest results are printed in italics and bracketed respectively.

TABLE LXXVII.
KUALA LUMPUR WATER SUPPLY.
Chemical Averages for each month of the year 1931.
Parts per 100,000 (unless otherwise stated).
IMPOUNDING RESERVOIR—FILTERED WATER (44 SAMPLES).

1931, Month.	Colour M.M. Brown 2-ft. tube, Burgess's Tintometer.	Reaction pH.	Ammoniacal nitrogen.	Albuminoid nitrogen.	Oxidised nitrogen.	Oxygen absorbed from acid permanganate in 3 hours at 80°F.	Chlorides expressed as chlorine.	Total solids.	Total hardness.
Averages 1930..	19	6.3	.0001	.0039	.004	.093	.07	2.08	.3
January ...	17	6.3	.0000	.0044	(.012)	.093	.07	(2.20)	0.3
February ...	17	6.3	.0000	.0043	.021	.094	.08	2.25	...
March ...	19	6.3	.0000	.0035	...	.093	.09	...	...
April ...	21	6.4	.0000	.0044	...	.097	.07	...	...
May ...	28	6.3	.0001	.0036	...	.098	.07	...	...
June ...	21	6.3	.0001	.0036	...	.086	.07	...	...
July ...	19	6.3	.0000	.0046	...	.098	.07	...	...
August ...	14	6.3	.0001	.0028	...	(.072)	.07	...	...
September ...	13	6.3	.0000	.0080	...	.129	.07	...	...
October ...	(9)	6.3	.0000	.0036	...	.079	.07	...	...
November ...	10	6.3	.0004	(.0027)	...	.080	.07	...	...
December ...	15	6.3	.0001	.0030	...	.088	.07	...	...
Averages 1931...	17	6.3	.0000	.0040	.016	.092	.07	2.22	0.3

The highest and lowest results are printed in italics and bracketed respectively.

TABLE LXXVIII.
AVERAGES, YEARS 1921-1931.
KUALA LUMPUR WATER SUPPLY—IMPOUNDING RESERVOIR
AT AMPANG (RAW WATER).
Parts per 100,000 (unless otherwise stated).

Years 1921-1931.	Colour M.M. Brown in a 2-ft. tube.	Reaction pH.	Ammoniacal nitrogen.	Albuminoid nitrogen.	Oxidised nit- rogen.	Oxygen absorbed from permanga- nate 3 hours at 80°F.	Chlorides as chlorine.	Total solids.	Rainfall in inches (total).
1921...	...	...	.0006	.0124	.002	.161	.06	4.0	...
1922...	...	...	.0009	.0131	.003	.164	.07	4.4	96.87
1923...	22	...	.0007	.0116	.004	.173	.07	4.0	100.87
1924...	21	...	.0006	.0111	.002	.151	.07	4.3	91.28
1925...	26	7.5	.0005	.0102	.004	.148	.07	4.5	138.38
1926...	29	6.5	.0004	.0106	.003	.152	.07	3.8	110.57
1927...	32	6.9	.0005	.0107	.002	.134	.07	4.5	123.89
1928...	31	6.6	.0005	.0095	.002	.146	.07	3.5	87.83
1929...	32	6.5	.0004	.0099	.003	.150	.07	2.7	76.60
1930...	31	6.5	.0006	.0075	.001	.151	.07	3.0	90.48
1931...	23	6.4	.0061	.0085	.000	.151	.07	3.0	103.21
Average for 11 years.	27	6.7	.0010	.0105	.002	.153	.07	3.8	...

TABLE LXXIX.
AVERAGES, YEARS 1919-1931.
KUALA LUMPUR WATER SUPPLY—IMPOUNDING RESERVOIR
AT AMPANG (FILTERED WATER).
Parts per 100,000 (unless otherwise stated).

Years 1919-1931.	Colour M.M. Brown in a 2-ft. tube.	Reaction pH.	Ammoniacal nitrogen.	Albuminoid nitrogen.	Oxidised nit- rogen.	Oxygen absorbed from permanga- nate 3 hours at 80° F. ^{per litre}	Chlorides as chlorine.	Total solids.	Hardness (total).
1919...	...	...	.0010	.0094	.010	.074	.08	...	...
1920...	...	...	.0005	.0074	.010	.083	.06	5.5	1.6
1921...	...	...	.0001	.0047	.011	.082	.06	3.1	...
1922...	...	...	.0001	.0047	.007	.083	.07	3.4	...
1923...	18	...	.0002	.0043	.006	.104	.07	3.5	...
1924...	17	...	.0008	.0055	.004	.089	.06	3.6	...
1925...	19	7.0	.0001	.0056	.005	.085	.07	4.0	...
1926...	16	6.0	.0000	.0041	.005	.076	.07	3.2	0.1
1927...	18	6.6	.0002	.0041	.004	.070	.07	3.8	...
1928...	16	6.5	.0002	.0037	.007	.080	.07	2.7	0.4
1929...	17	6.4	.0001	.0038	.005	.085	.07	2.2	0.4
1930...	19	6.3	.0001	.0039	.004	.093	.07	2.1	0.3
1931...	17	6.3	.0000	.0040	.016	.092	.07	2.2	0.3
Average for 13 years	17	6.5	.0003	.0050	.007	.084	.07	3.3	0.5

TABLE LXXX.
KUALA LUMPUR WATER SUPPLY.
Chemical Averages for each month of the year 1931.
Parts per 100,000 (unless otherwise stated).
INTAKE WORKS—RAW WATER (49 SAMPLES).

1931. Month.	Colour M.M. Brown 2-ft. tube, Burgess's Tintometer.	Reaction pH.	Ammoniacal nitrogen.	Albuminoid nitrogen.	Oxidised nitrogen.	Oxygen absorbed from acid permanganate in 3 hours at 80° F.	Chlorides expressed as chlorine.	Total solids.	Total hardness.	Rainfall in inches (total).
Averages 1930 ...	36	6.5	.0001	.0048	.004	.169	.07	2.87	.3	106.98
January ...	29	6.5	.0003	.0049	.006	.147	.08	2.50	0.5	10.09
February ...	23	6.5	.0000	(.0035)	...	(.124)	.08	...	...	3.77
March ...	34	6.4	.0001	.0061	...	.208	.08	...	...	6.73
April ...	46	6.4	.0004	.0060	...	.237	.07	...	...	10.16
May ...	41	6.4	.0003	.0052	...	.203	.07	...	...	7.99
June ...	33	6.4	.0000	.0044	...	.161	.07	...	...	8.05
July ...	32	6.4	.0000	.0048	.000	.165	.07	(1.50)	(0.2)	7.73
August ...	23	6.4	.0001	.0042	...	.137	.07	...	...	3.81
September ...	23	6.4	.0004	.0040	...	.141	.07	...	...	8.86
October ...	19	6.5	.0003	.0042	...	.161	.07	...	...	7.82
November...	17	(6.3)	.0000	.0049	...	.161	.07	...	...	14.61
December...	(15)	(6.3)	.0002	.0049	...	.161	.07	...	...	13.94
Averages 1931 ...	28	6.4	.0002	.0048	.003	.167	.07	2.00	0.3	103.56

The highest and lowest results are printed in italics and bracketed respectively.

TABLE LXXXI.
KUALA LUMPUR WATER SUPPLY.
Chemical Averages for each month of the year 1931.
Parts per 100,000 (unless otherwise stated).
INTAKE WORKS—FILTERED WATER (50 SAMPLES).

1931. Month.	Colour M.M. Brown 2-ft. tube, Burgess's Tintometer.	Reaction pH.	Ammoniacal nitrogen.	Albuminoid nitrogen.	Oxidised nitrogen.	Oxygen absorbed from acid permanganate in 3 hours at 80°F.	Chlorides expressed as chlorine.	Total solids.	Total hardness.
Averages 1930 ...	29	6.5	.0001	.0037	.006	.135	.07	2.00	.5
January ...	29	6.5	.0000	.0040	.007	.164	.07	3.00	0.3
February ...	24	6.7	.0000	.0031	(.002)	(.093)	.07	3.08	...
March ...	32	6.5	.0000	.0038	...	.157	.07	2.95	...
April ...	37	6.5	.0000	.0046	...	.182	.06	3.89	...
May ...	41	6.5	.0000	.0044	...	.158	.07	4.42	...
June ...	28	6.5	.0000	.0042	...	.147	.07	2.46	...
July ...	26	6.5	.0000	.0038	...	.132	.07	4.50	...
August ...	21	(6.4)	.0000	.0040	...	.118	.07	4.02	...
September ...	20	(6.4)	.0000	.0035	...	.127	.07	(2.33)	...
October ...	16	(6.4)	.0000	.0038	...	.142	.06	2.56	...
November ...	(14)	6.5	.0000	.0041	...	.138	.07	3.27	...
December ...	16	6.5	.0000	(.0030)	...	.109	.07	5.65	...
Averages 1931 ...	25	6.5	.0000	.0039	.004	.139	.07	3.51	0.3

TABLE LXXXII.
KUALA LUMPUR WATER SUPPLY.
Chemical Averages for each month of the year 1931.
Parts per 100,000 (unless otherwise stated).
INTAKE WORKS—FILTERED WATER + CHLORINATION (85 SAMPLES).

1931. Month.	Colour M.M. Brown 2-ft. tube, Burgess's Tintometer.	Reaction pH.	Ammoniacal nitrogen.	Albuminoid nitrogen.	Oxidised nit- rogen.	Oxygen absorbed from acid per- manganate in 3 hours at 80 °F.	Chlorides ex- pressed as chlorine.	Total solids.
January ...	21	6.5	.0000	.0038	.005	.134	(.09)	3.11
February ...	20	6.5	.0000	(.0031)	(.004)	(.092)	(.09)	3.05
March ...	23	6.4	.0001	.0036	...	.122	.11	3.18
April ...	34	6.5	.0000	.0044	...	.169	(.09)	4.70
May ...	38	6.4	.0001	.0038	...	.152	(.09)	3.45
June ...	29	6.4	.0000	.0042	...	.141	(.09)	3.78
July ...	23	6.5	.0000	.0042	...	.156	.10	4.46
August ...	17	6.4	.0000	.0037	...	.100	.11	2.89
September ...	18	6.4	.0000	.0037	...	.116	.10	2.99
October ...	14	6.4	.0000	.0038	...	.133	.11	2.67
November ...	(12)	6.5	.0000	.0049	...	.133	(.09)	(2.08)
December ...	13	6.5	.0000	.0039	...	.169	.10	3.41
Averages 1931	22	6.5	.0000	.0039	.004	.130	.10	3.31

The highest and lowest results are printed in italics and bracketed respectively.

TABLE LXXXIII.
AVERAGES, YEARS 1921-1931.
KUALA LUMPUR WATER SUPPLY—AMPANG INTAKE WORKS
(RAW WATER).
Parts per 100,000 (unless otherwise stated).

Years 1921-1931.	Colour M.M. Brown in a 2-ft. tube.	Reaction pH.	Ammoniacal nitrogen.	Albuminoid nitrogen.	Oxidised nit- rogen.	Oxygen absorbed from permanga- nate 3 hours at 80° F.	Chlorides as chlorine.	Total solids.	Rainfall in inches (total).
1921...	...	...	.0005	.0055	.003	.155	.06	5.1	...
1922...	...	...	.0006	.0067	.004	.176	.06	3.8	110.60
1923...	...	...	.0008	.0071	.005	.185	.06	4.0	104.88
1924...	24	...	.0008	.0051	.005	.156	.05	4.3	99.31
1925...	27	7.5	.0005	.0066	.006	.170	.06	4.2	144.86
1926...	30	6.5	.0003	.0071	.005	.176	.06	3.8	118.50
1927...	34	6.8	.0003	.0091	.004	.151	.06	4.5	128.20
1928...	37	6.7	.0007	.0110	.003	.197	.06	4.2	87.46
1929...	36	6.5	.0002	.0054	.005	.187	.07	2.9	109.45
1930...	36	6.5	.0001	.0048	.004	.169	.07	2.9	106.98
1931...	28	6.4	.0002	.0048	.003	.167	.07	2.0	103.56
Average for 11 years ...	31	6.7	.0005	.0067	.004	.171	.06	3.8	...

TABLE LXXXIV.
AVERAGES, YEARS 1919-1931.
KUALA LUMPUR WATER SUPPLY—AMPANG INTAKE WORKS
(FILTERED WATER).
Parts per 100,000 (unless otherwise stated).

Years 1919-1931.	Colour M.M. Brown in a 2-ft. tube.	Reaction pH.	Ammoniacal nitrogen.	Albuminoid nitrogen.	Oxidi nitrogen.	Oxygen absorbed from permanga- nate in 3 hours 80° F.	Chlorides as chlorine.	Total solids.	Hardness (total).
1919...	...	...	.0010	.0078	.010	.111	.08	...	...
1920...	...	...	.0005	.0064	.009	.126	.07	6.0	1.6
1921...	...	...	.0002	.0044	.007	.120	.06	4.4	...
1922...	...	...	.0001	.0048	.005	.132	.06	3.5	...
1923...	22	...	.0002	.0046	.007	.146	.06	3.6	...
1924...	21	...	.0003	.0033	.006	.115	.05	3.8	...
1925...	23	8.0	.0001	.0044	.006	.105	.06	4.0	...
1926...	22	7.5	.0000	.0044	.005	.108	.06	3.9	0.4
1927...	22	7.1	.0001	.0035	.004	.084	.06	3.9	...
1928 ..	25	6.9	.0003	.0037	.003	.119	.06	3.5	0.7
1929...	28	6.7	.0001	.0039	.005	.135	.07	2.9	0.5
1930...	29	6.5	.0001	.0037	.006	.135	.07	2.0	0.5
1931...	25	6.5	.0000	.0039	.004	.139	.07	3.5	0.3
Averages for 13 years ...	24	7.0	.0002	.0045	.006	.121	.07	3.7	0.7

TABLE LXXXV.

TOTAL NUMBER OF SAMPLES EXAMINED DURING THE
YEARS 1930 AND 1931.

	1930.	1931.
<i>Medical Department—</i>		
Water	2,177	2,221
Milk	840	889
Sewage, effluents, etc. ...	93	106
Toddy	28	—
Biochemical examinations ...	249	147
Toxicological examinations ...	30	12
Miscellaneous	124	155
<i>Police Department—</i>		
Coins and coining material ...	2,211	1,166
Articles for blood stains* ...	233	—
Toxicological examinations ...	132	177
Deleterious drugs	8	24
Miscellaneous	79	194
<i>Veterinary Department—</i>		
Milks	30	38
Toxicological examinations ...	1	23
Miscellaneous	4	6
<i>Other Departments</i>	33	31
<i>Private Analyses</i>	40	19
	<hr/> 6,312	<hr/> 5,208

DIVISION OF MALARIA RESEARCH.

(DR. R. GREEN.)

Examination of Blood Films.

During the year, 7,569 thin and thick blood films have been examined for malaria parasites. These consisted of the following:

Parasite counts (fowl-corpuscle method) ...	3,455
Thick films from rubber estate labourers ...	1,525
Thick films from hospital cases	915
Thin films from hospital cases	720
Thick films from Sakai	165
Thick films from monkeys	789

Parasite Surveys.

A number of reports on parasite and spleen surveys undertaken in connection with various researches have been supplied to local practitioners. Interim reports on the progress of investigations on drugs, etc., have been forwarded to individuals particularly interested and to the Secretary, Malaria Commission, League of Nations.

* These examinations are no longer undertaken by the Chemical Division.

Grouping Sera.

Grouping sera has been prepared in the Division for certain investigations and supplied locally in connection with grouping for blood transfusions on twenty occasions. Supplies have also been forwarded to Hong Kong and to Borneo.

Instruction.

Instruction has been given to medical men and others in thick film work, methods of mosquito dissection, and technique of examination of mid-guts and salivary glands. Five selected dressers from various hospitals have attended for a course in thick film work. This course lasted some weeks and a fair standard of efficiency was attained.

DIVISION OF ENTOMOLOGY.

(MR. E. P. HODGKIN.)

As in previous years, a large number of mosquitoes have been identified for Health Officers, private practitioners and others. For Health Officers, 7,150 anophelines and 2,620 culicines have been examined, and for medical practitioners, 55 anophelines and two culicines.

A number of other insects of supposed medical or veterinary importance have also been received and reported on; these included ticks, fleas, flies and blood-sucking bugs.

Instruction.

Instruction in the identification of local anophelines was given to a number of Health Officers, Sanitary Inspectors, and others.

TABLE LXXXVI.

TEMPERATURE AND HUMIDITY IN THE INSECTARIUM DURING 1931.

Month.	Temperature in degrees Fahrenheit.						Percentage Humidity.		
	Mean.		Absolute extremes.				Means.		
	Max.	Min.	Highest Max.	Lowest Min.	Lowest Max.	Highest Min.	8 a.m.	12 noon.	* 4 p.m.
January ...	86.0	75.6	91.0	74.0	76.8	77.0	85.0	69.8	70.9
February ...	90.4	76.4	92.5	74.0	87.5	79.0	82.2	59.5	58.2
March ...	90.5	77.4	92.5	75.0	87.0	79.0	81.6	62.8	69.5
April ...	84.4	77.4	91.5	75.5	85.0	79.0	84.0	66.4	72.5
May ...	88.9	79.9	92.0	76.0	85.0	80.5	81.7	68.3	72.0
June ...	87.5	76.6	90.5	73.0	81.0	79.0	82.5	70.2	73.4
July ...	86.4	75.2	88.5	72.0	83.0	77.5	83.5	68.0	72.2
August ...	87.7	76.2	91.5	74.0	82.0	78.5	81.8	68.3	66.3
September ...	86.9	75.5	91.0	72.0	80.5	78.5	83.2	68.6	71.7
October ...	86.2	75.6	90.0	73.0	81.5	77.5	81.6	69.1	69.2
November ...	85.4	75.1	87.5	73.0	79.0	76.5	84.9	69.1	74.2
December ...	84.2	74.8	88.0	72.5	76.0	77.0	86.0	71.1	74.8

* These figures are based on readings taken five days a week only.

V.—ACKNOWLEDGMENTS.

Valuable assistance in connection with various matters is gratefully acknowledged from the following Government Departments and Institutions: The Agricultural, Forestry, Museum, Survey, and Veterinary Departments; the British Museum; Bureau of Hygiene and Tropical Medicine, London; the Colonial Medical Research Committee; the Eastern Bureau, League of Nations, Health Organisation, Singapore; the National Collection of Type Cultures, London; the National Institute of Health, Washington, United States of America; the Public Health Laboratories, London; the Rubber Research Institute of Malaya; the Standards Laboratory, Oxford; and the Wellcome Research Laboratories, Kent.

The Institute is also indebted to the following gentlemen: Dr. Ansley Young, Lt.-Col. C. J. Arnold, Dr. Barclay Barrowman, Dr. G. E. Beggs, Dr. C. Boden Kloss, Dr. Bonne, Dr. O'Brien, Dr. I. G. Cameron, Mr. G. H. Corbett, Mr. W. T. Dawson, Professor E. C. Dodds, Lt.-Col. B. J. Eaton, Dr. W. Fletcher, Dr. A. V. Greaves, Dr. W. B. Haines, Dr. S. C. Howard, Mr. J. Iribarne, Col. S. P. James, Dr. D. C. Macaskill, Dr. G. C. Macgregor, Col. Mackie, Mr. J. F. Marshall, Mr. D. W. McCrow, Dr. de Moor, Col. Morrison, Dr. J. B. Orr, Mr. H. M. Pendlebury, Dr. W. T. Quaife, Dr. J. G. Reed, Mr. G. Shelton Agar, Mr. P. G. Shute, Professor Snijders, Dr. O. Urchs, Dr. L. Verney, Dr. C. M. Wenyon and Mr. J. S. Weston.

Numerous officers of the Medical and Health Branches of the Malayan Medical Service have assisted by the provision of facilities, material and information, and especially the following: Drs. P. S. Selwyn-Clarke, A. K. Cosgrave, W. C. Diamond, P. H. Hennessy, H. P. Hodge, R. S. Johnston, P. D. Johnson, N. K. Sen, J. W. Scharff, D. T. Skeen, E. C. Vardy, W. J. Vickers, T. C. Wakefield, (Mrs.) M. J. Were and Professor W. A. Young.

VI.—STAFF CHANGES.

Dr. A. Neave Kingsbury resumed duty on 3rd February on his return from the International Congress on Leprosy held at Manila under the auspices of the Leonard Wood Memorial.

Dr. P. H. Martin, Pathologist, acted as Director from the commencement of the year until 2nd February. He was appointed Bacteriologist on 3rd December.

Mr. R. W. Blair, Chief Chemist, proceeded on leave on the 11th of March, and resumed duty on 15th November.

Dr. R. Lewthwaite, Pathologist II, resumed duty on his return from leave on 20th May. He acted as Pathologist I from that date until 2nd December, and was appointed to that post as from 3rd December.

Mr. J. Shelton, Chemist, acted as Chief Chemist from 12th March to 14th November.

Mr. G. H. Corbett, Government Entomologist, continued to act as Consulting Entomologist until 19th March.

Dr. L. Anigstein, Research Student, was released from service from 15th January, in order to proceed to Siam where he reported on the malaria situation on behalf of the Malaria Commission, Health Organisation, League of Nations.

Dr. J. W. Field, Medical Officer, was appointed Malaria Research Officer II on 30th May. He proceeded to Ipoh to take charge of the Branch Laboratory on 9th November.

Dr. C. Russell Amies, Malaria Research Officer II, proceeded to England on 29th May on the termination of his agreement.

Dr. H. M. Nevin, Medical Officer attached, who had been in charge of the Branch Laboratory, Ipoh, proceeded on leave on 2nd August.

Mr. E. P. Hodgkin, Entomologist, was appointed on 20th February, and assumed duty on 20th March.

Dr. J. E. Lesslar, Senior Deputy Pathologist, retired owing to ill-health on 12th May.

Dr. K. Kanagarayer, Deputy Bacteriologist, was in charge of the Branch Laboratory at Ipoh from 3rd August until 8th November.

Dr. R. Mukerji, Assistant, Bacteriological Division, was appointed on 8th and assumed duty on 18th May. He resigned on 31st December, in order to return to India.

Mr. R. Mailvaganam, Chief Clerk, proceeded on leave prior to retirement on 12th February.

Mr. V. Thamboo has acted as Chief Clerk from 13th February.

VII.—PUBLICATIONS.

BULLETINS FROM THE INSTITUTE FOR MEDICAL RESEARCH, 1931.

No. 1.—“Notes on the Use of Thick Blood Films in the Diagnosis of Malaria,” by Richard Green.

No. 2.—“The Concentration of Vitamin B. 1 from Rice Polishings,” by I. A. Simpson.

No. 3.—“The Attempted Control of Malaria by Plasmoquine Prophylaxis,” by A. Neave, Kingsbury and C. Russell Amies.

No. 4.—“The Relative Susceptibility of Some Malayan Anopheline Mosquitoes to Experimental Infection with Malarial Parasites,” by Richard Green and B. A. R. Gater.

No. 5.—“Laboratory Experiments on the Larvicidal Properties of Mineral Oils,” by G. H. Corbett and E. P. Hodgkin.

OTHER PAPERS.

1.—“A Field Experiment on the Value of Plasmoquine in the Prophylaxis of Malaria,” by A. Neave Kingsbury and C. Russell Amies. *Trans. Roy. Soc. Trop. Med. and Hyg.*, 1931. Vol. XXV, 159

2.—“A Malarial Parasite of *Macacus*, and its Development in Mosquitoes,” by Richard Green. *Trans. Roy. Soc. Trop. Med. and Hyg.* 1931, XXIV, 649.

3.—“The Collection of Pathological Specimens for Examination with Notes on the Interpretation of Certain Laboratory Findings,” by K. Kanagarayer. *Malayan Medical Journal*, 1931. Vol. VII. 110.

A. NEAVE KINGSBURY,
Director, Institute for Medical Research,
Federated Malay States.

APPENDIX II.

ANNUAL REPORT OF THE CHIEF MEDICAL OFFICER,
SOCIAL HYGIENE, FEDERATED MALAY STATES,
FOR THE YEAR 1931.

During the year 1931, 31,817 patients were treated for venereal disease at Government Medical Institutions in the Federated Malay States.

As compared with the year 1930, a reduction of 3,917 cases occurred. This fall was confined to Chinese patients alone. The number of Tamil patients treated remained stationary, while that of the Malay, Eurasian and European races showed slight increases.

The Women and Girls' Protection Act (1930) was in force throughout the year, and by the end of February there were no licensed brothels in the Federated Malay States.

A comparative table shows :

Year.	No. of brothels in F.M.S.		No. of inmates.	
1929	...	167	...	1,255
1930	...	107	...	641
1931 (after February)	...	—	...	—

The Federated Malay States has thus fallen into line with most other countries and is now dealing with the problem of venereal disease at one of its main sources, i.e., the imported licensed prostitute.

It is yet too early to draw definite conclusions as to the result of this recent legislation, and more especially so since the year 1931 was one of slump conditions and decreasing immigrant population. These two factors must be given due weight when considering the incidence of venereal disease. But since this act affected the Chinese population far more than any other race, a substantial fall in the number of Chinese patients treated is significant, and particularly so when other races failed to show equivalent reductions.

Eighty-eight thousand seven hundred and sixteen injections of arsenical and bismuth compounds were given in the treatment of syphilis. This represents a ratio of 4.8 injections per patient, and is a further improvement on previous years, though still too low to eradicate the disease.

The following table shows the nationality, diseases and number of those treated throughout the Federated Malay States for the years 1930 and 1931.

Nationality.	Syphilis.		Gonorrhoea.		Soft sore.		Total Number.	
	1930.	1931.	1930.	1931.	1930.	1931.	1930.	1931.
Chinese	13,149	10,424	5,174	4,059	1,079	840	19,402	15,323
Tamils	5,420	5,021	3,728	3,928	920	819	9,888	9,768
Malays	2,174	2,100	1,140	1,253	78	78	3,392	3,431
Sikhs	852	830	589	710	105	155	1,546	1,695
Eurasians	56	70	130	133	5	5	191	208
Europeans	69	87	364	350	22	27	455	464
Others	480	510	348	366	32	52	860	928
Total	22,020	19,042	11,473	10,799	2,241	1,976	35,734	31,817

The graph at the end of this report represents the progress since 1926.

A report on Social Hygiene measures falls, naturally, under two heads:

A.—Propaganda and Education.

B.—Treatment Centres and Treatment.

A.—PROPAGANDA.

Propaganda work by means of lantern lectures to clubs and associations has been maintained, and this year simple addresses have been given to the senior boys of some large schools. A number of dressers from all States received special courses of instruction at the Kuala Lumpur clinic.

The Chinese-speaking population was reached by a lecturer appointed by the Committee for Public Health Education. He toured the country, and gave many lantern lectures—some in the open air and some in clubs.

Valuable help and co-operation has been given by the District Officers.

A Social Hygiene Section was on view at:

(a) The Malayan Agri-Horticultural Exhibition, Kuala Lumpur.

(b) “Health Week”, Taiping.

(c) Chinese Flood Relief Fair, Ipoh.

At each, several thousand persons visited the sections and showed interest in the exhibits and slides. The British Social Hygiene Society provided very striking posters.

Posters and Pamphlets.—Posters in English, Malay, Chinese, Tamil and Urdu are prominently displayed at all Government hospitals and dispensaries, and pamphlets in these languages are given away.

Chinese Woman Almoners.—The successful work done by the Kuala Lumpur almoner justified the appointment, during the year, of another such person in Ipoh. These women work amongst the sly prostitutes and by tact and sympathy get them to attend for treatment when necessary. It is difficult work, and care has to be exercised in selecting suitable persons.

These appointments have been particularly useful this year, as many of the prostitute class reasoned that if licensed prostitution was illegal the less they had to do with the Government Institutions the better for themselves. This apprehension is now rapidly abating.

B.—TREATMENT CENTRES AND TREATMENT.

There are fifty-nine treatment centres in the Federated Malay States. They may be classified as follows:

(1) *The Social Hygiene Clinics* in Kuala Lumpur, Klang, Seremban, Taiping, Ipoh and Telok Anson. Here the bulk of the work is the treatment of venereal disease, combined with that of general disease. All these clinics have specially trained assistant medical officers, dressers, nurses and amahs.

(2) *The hospitals*, where in-door and out-door treatment is available.

(3) *The dispensaries.*—These provide routine irrigation treatment, and are visited weekly by a medical officer or assistant medical officer for treatment with intravenous injections. Nearly all the dressers in charge of these dispensaries have undergone a course of special training at the Kuala Lumpur clinic.

SELANGOR.

The Social Hygiene Clinic and Town Dispensary at Sultan Street, Kuala Lumpur.

The premises consist of two shop-houses, one of which contains the town dispensary and the female clinic, and the other the male clinic.

The following table shows the nationality, disease and the numbers treated during the years 1930 and 1931:

Nationality.	Syphilis.		Gonorrhoea.		Soft sore.		Total.	
	1930.	1931.	1930.	1931.	1930.	1931.	1930.	1931.
Chinese	1,466	1,375	1,902	836	221	156	3,589	2,367
Tamils	416	471	533	652	139	170	1,088	1,293
Malays	155	143	136	92	11	5	302	240
Sikhs	110	126	88	116	37	45	235	287
Eurasians	26	28	44	39	1	...	71	67
Europeans	19	34	185	188	13	12	217	234
Others	90	60	114	58	4	10	208	128
Total	2,282	2,237	3,002	1,981	426	398	5,710	4,616

Prophylactic treatment 544 persons in 1931.

The racial proportion is similar to that of former years.

The following table shows the source of infection of the various nationalities and the percentage stated to be under the influence of alcohol at time of exposure:

Nationality.	Chinese licensed.	Chinese sly.	Tamils.	Malays.	Sikhs.	Eurasians.	Europeans.	Siamese.	Japanese.	Percentage stated to be under the influence of alcohol.
Chinese ...	512	1,030	...	12	...	1	...	5	6	13.8
Tamils ...	1	221	612	281	...	2	...	30	37	17.32
Malays ...	...	34	1	154	...	...	...	2	2	3.1
Sikhs ...	1	158	11	52	17	2	...	...	...	25.3
Eurasians ...	...	19	1	22	...	1	...	3	11	27.6
Europeans ...	...	63	7	69	...	1	5	82	1	31.7
Total ...	514	1,525	632	590	17	7	5	122	57	18%

Female Section, Sultan Street.

The following table shows the numbers, diseases and nationality of patients:

Nationality.	Syphilis.	Gonorrhoea.	Soft sore.	Total.
Chinese ...	538	263	—	801
Tamils ...	66	41	—	107
Malays ...	38	9	—	47
Sikhs ...	30	16	—	46
Eurasians ...	6	3	—	9
Europeans ...	1	3	—	4
Others ...	16	5	—	21
Total ...	695	340	—	1,035

The section, as in all the larger towns, works in close co-operation with the Infant Welfare Centre, and received from it many women for the ante-natal treatment of syphilis and of children infected with venereal disease. Seventy-one children were treated for congenital syphilis and nineteen for gonorrhoea.

The Federal Home for Women and Girls, Kuala Lumpur.

This institution has been visited weekly. Sixty-seven inmates required specific treatment.

Klang Social Hygiene Clinic.

Numbers treated during 1930	...	2,367
Numbers treated during 1931	...	2,218

PERAK.

Social Hygiene Clinic, Taiping.

Number of patients treated during 1930	...	1,835
Number of patients treated during 1931	...	1,755

A new dispensary was ready for occupation early in the year and replaced poor accommodation in two shop-houses.

Social Hygiene Clinic, Ipoh.

Number of patients treated during 1930 ...	4,557
Number of patients treated during 1931 ...	4,299

Social Hygiene Clinic, Teluk Anson.

The new town dispensary provided very suitable accommodation for a social hygiene clinic. A specially trained Assistant Medical Officer, dresser and nurse were appointed to it early in the year. One thousand and eighty-five patients, including 379 women were treated. The clinic serves a large area, and has already justified its establishment.

NEGRI SEMBILAN.**Social Hygiene Clinic, Seremban.**

Number of patients treated during 1930 ...	2,548
Number of patients treated during 1931 ...	2,335

Treatment.

A diathermy apparatus was purchased in England and installed at the Kuala Lumpur clinic. This treatment has been of great service in cases of chronic gonorrhoea and sequelae.

Patients suffering from neuro-syphilis have been treated with tryparsamide, and this preparation has given definitely better results than injections of N.A.B.

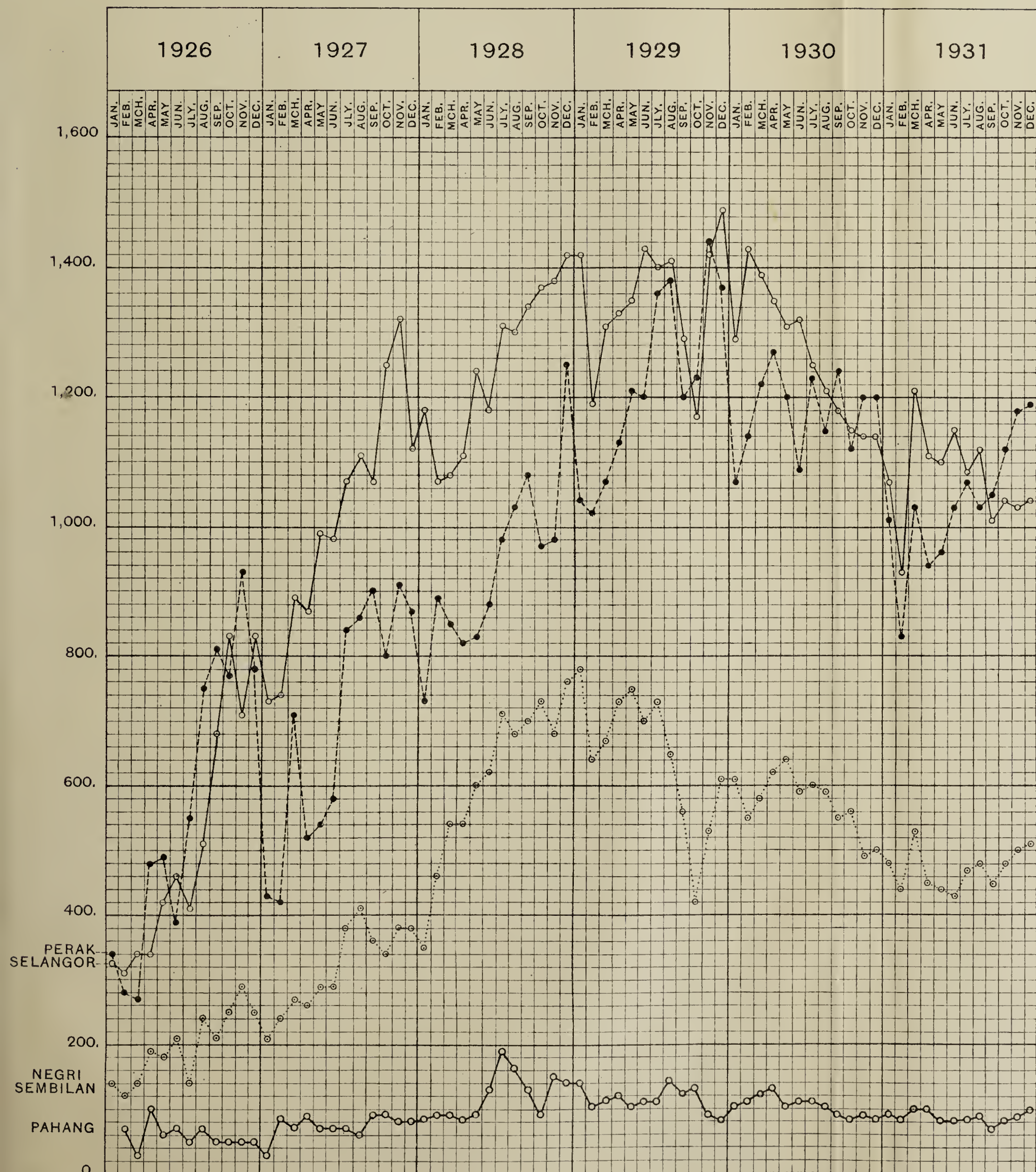
For the routine treatment of early syphilis, N.A.B. has largely replaced stabilarsan and, in accordance with modern ideas, larger initial doses of both it and bismostab have been given—and with safety.

E. R. C. COOKE,

Chief Medical Officer, Social Hygiene, F.M.S.



GRAPH NO. 1
FEDERATED MALAY STATES
GRAPH SHOWING NUMBERS TREATED FROM JANUARY 1926.



LIST OF HOSPITALS, DISPENSARIES, ETC. IN THE F. M. S.

FEDERATED MALAY STATES 1931

Scale 10 5 0 10 20 Miles

PERAK

- 1 BAGAN DATOH
A Dispensary
- 2 BAGAN SERAI
A Dispensary
- 3 BATU GAJAH
Two Hospitals
A Dispensary
- 4 CAMERON'S HIGHLANDS
A Dispensary at Tanah Rata and at Ringlet
- 5 GOPENG
A Dispensary
- 6 GRIK
A Hospital
- 7 IPOH
A Dispensary
A Hospital
An Infant Welfare Centre
Two Health Officers
School Welfare Centre
- 8 KAMPAR
A Hospital
- 9 KLIAN INTAN
A Hospital
- 10 KROH
A Dispensary
- 11 KUALA KANGSAR
Three Hospitals
A Health Officer
A Dispensary at Bota
- 12 KUALA KURAU
A Dispensary
- 13 LENGGONG
A Dispensary
- 14 PARIT
A Dispensary
- 15 PARIT BUNTAR
A Hospital
- 16 SELAMA
A Dispensary
- 17 SITIawan
A Hospital
- 18 SUNGKAI
A Hospital

TAIPING

- Two Hospitals
An Infant Welfare Centre
A Health Officer
A Dispensary
- 20 TANJONG MALIM
A Hospital
- 21 TAPAH
A Hospital
A Health Officer
- 22 TELUK ANSON
A Hospital
A Health Officer
An Infant Welfare Centre
A Dispensary at Pulau Tiga

SELANGOR

- 1 FRASER'S HILL
A Dispensary
- 2 GAP
A Dispensary
- 3 KAJANG
A Hospital
- 4 KLANG
A Hospital
An Infant Welfare Centre
A Dispensary
A Health Officer
- 5 KUALA KUBU
A Hospital
A Health Officer
- 6 KUALA LUMPUR
Four Hospitals
A Town Dispensary
Three Health Officers
A Dental Clinic
A School Welfare Centre
- 7 KUALA SELANGOR
A Hospital
- 8 PORT SWETTENHAM
A Dispensary
A Quarantine Camp and Hospital
A Health Officer

- 9 RASA
A Dispensary
- 10 RAWANG
A Dispensary
- 11 SABAK BERNAM
A Dispensary
- 12 SEPANG
A Dispensary
- 13 SERENDAH
A Hospital
- 14 SUNGEI BESI
A Dispensary
- 15 SUNGEI BULOH
Lepet & Deoripit Settlements
- 16 TELUK DATOH
A Dispensary

NEGRI SEMBILAN

- 1 GEMAS
A Dispensary
- 2 JELEBU
A Hospital
A Dispensary
- 3 KUALA PILAH
Two Hospitals
A Dispensary
- 4 MANTIN
A Dispensary
- 5 PORT DICKSON
A Hospital
- 6 REMBAU
A Dispensary
- 7 SEREMBAN
Two Hospitals
An Infant Welfare Centre
A Dispensary
A Health Officer

- 8 TAMPIN
A Hospital
A Health Officer

PAHANG

- 1 BENTONG
A Hospital
- 2 KUANTAN
A Hospital
A Health Officer
- 3 KUALA LIPIS
A Hospital
A Health Officer
- 4 MENTAKAB
A Hospital
- 5 PEKAN
Two Hospitals
- 6 PONTIAN
A Dispensary
- 7 PULAU TIOMAN
A Dispensary
- 8 RAUB
A Hospital
- 9 ROMPIN
A Dispensary
- 10 TEMERLOH
A Dispensary

REFERENCE

- Railway Line Open
" Under Construction
Roads
State Boundary
Hospital
Dispensary
Infant Welfare Centre
Health Officer
Dental Clinic
School Welfare Centre
Cart Track
Foot Path

